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THE

CHEMICAL NEWS:

WITH WHICH IS INCORPORATED THE

CHEMICAL GAZETTE:

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

NEW YORK
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EDITED BY

WILLIAM CROOKES, F.C.S.

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ADVERTISEMENT.

LITTLE, we believe, need be said of the advantages of the rapid dissemination of scientific information, and that little has been so well said by a great scientific authority, that we make no apology for quoting here from a work so well known as Sir JOHN HERSCHEL'S *Preliminary Discourse on the Study of Natural Philosophy.*

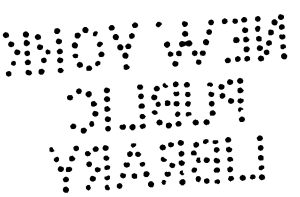
"Perhaps it may be truly remarked," says that distinguished man, "that, next to the establishment of institutions having either the promotion of science in general, or, what is still more practically efficacious in its present advanced state, that of particular departments of physical inquiry for their express objects, nothing has exercised so powerful an influence on the progress of modern science as the publication of scientific journals, of which there is now scarcely a nation in Europe which does not produce several. The quick and universal circulation of these, places observers in all countries on the same level of perfect intimacy with each others objects and methods, and serves to direct the course of general observation, as well as to hold out in the most conspicuous manner models for emulative imitation. Nothing can be more discouraging to one engaged in active research than the impression that all he is doing may, very likely, be labour taken in vain; that it may, perhaps, have been already done, and much better done than with his opportunities or his resources he can hope to perform it; and on the other hand nothing can be more exciting than the contrary impression. Thus by giving a connected view of what has been done, and what remains to be accomplished, those digests and bodies of science which from time to time appear have, in fact, a very important weight in determining its future progress, quite independent of the quantity of information they communicate."

What was so true in 1830 is still more so in 1860, for in these thirty years what progress has Chemistry made! In 1830 one moderately sized octavo volume contained all that was known of the science, and the names of the observers were comparatively few. To day a "Handbook" of Chemistry already extends to thirteen volumes, and is still uncompleted, while the name of the experimenters is "Legion." From this cause the continual additions made to our knowledge of the science renders a special work on the subject out of date almost as soon as printed. It was to supply the English Chemist with these constant extensions that the CHEMICAL NEWS was first projected, and it is confidently hoped that the design has been in a great measure fulfilled. That the attempt has been well received is sufficiently shown by the circulation and influence the Journal has already attained, and which is still extending.

In looking back over the contents of this volume the Editor sees much on which to congratulate himself and his readers. It is no small honour to a Journal to have been the means of preserving the interesting Lectures of FARADAY,— which, dealing with the elements of science, command the admiration of the learned as well as excite the interest of the student. To record the valuable experience of practical analysts like Messrs. FIELD and SUTTON, and the interesting researches of Messrs. WILLIAMS and CHURCH, cannot fail to have been useful: to these gentlemen, and many others, we have to offer our sincere thanks.

Nor should we omit to confess deep obligations to the various Foreign Scientific Journals from which, as our readers know, we abstract and quote liberally. It has therefore afforded us much pleasure to see that our continental *confrères* have as freely availed themselves of the original matter contributed to the CHEMICAL NEWS. The papers of Messrs. WILLIAMS, CHURCH, SPILLER, SUTTON, FIELD, BARRATT, ATTFIELD and others have been republished in several of the Chemical Journals of Germany and France, and so become permanent additions to the stock of European knowledge.

June, 1860.



THE CHEMICAL NEWS.

Vol. I. No. 1. — December 10, 1859.

INTRODUCTORY ADDRESS.

The diffusion of facts which may tend to improve and augment our knowledge of the arts and sciences upon which most of the operations of civilised life are based, must ever be a pleasing task to those who hold in esteem the welfare of mankind. It is with this feeling that the CHEMICAL NEWS is introduced to the world.

Chemical Science during the last quarter of a century has made such extended progress that our arts and manufactures assume altogether a different aspect. Those chemical arts which formerly were rudely conducted by the system termed the "rule of thumb," are now methodically organised and arranged in accordance with the unerring laws of chemistry, and the theoretical principles upon which each art is based, as well as its practice, now receive due attention from the more enlightened chemical manufacturer. Hence, not only are more accurate and uniform results obtained, but success and economy take the place of failure and waste. The general diffusion of scientific knowledge has done much to accomplish this desirable end; and to the scientific institutions and the press are due the credit of this great reformation.

The scientific journalists in this country,—availing themselves of the vast amount of discovery and improvement which has been from time to time freely given to the world by the Continental chemists in their numerous publications,—have duly recorded in our own language the results of the labours of our foreign scientific brethren; and thus some of the most useful and valuable arts which have ever been discovered by man, have, during the past twenty years, become universally spread over the globe; whereas, had it not been for the British Scientific Press, many of these valuable discoveries would have failed to receive that popularity or generalisation which extends their usefulness to all mankind, instead of merely benefiting the few. For it must be admitted that the general adoption of any well-tried process in Great Britain goes far to insure its application over the greater part of the civilised world.

At the present time, however,—remarkable though it may seem,—there is no WEEKLY JOURNAL in England which has for its aim the publication of those scientific processes and discoveries, the knowledge of which tends so greatly to increase our importance as a nation devoted to improvement, refinement, and industrial excellence. It is therefore to supply this deficiency that the CHEMICAL NEWS is now launched into the stream of scientific literature.

After a lengthened and careful deliberation upon the plan which it would be best to pursue; the present form and arrangement of subjects has been adopted in order to meet the views of all persons interested in scientific matters, either as chemical manufacturers, pharmaceutists, or amateur experimentalists, &c., and it is earnestly hoped that it may meet with that approval and support which it will ever be the desire of the Editor to ensure, based upon the solid foundations of merit and careful attention.

Each number will be divided into several sections, which will have a *general* but no *individual* connection with each other. We shall commence with SCIENTIFIC AND ANALYTICAL CHEMISTRY, under which head will be given the results of elaborate investigations in the laboratory, by those pioneers of our science who by their labours pave the way for the subjects treated of in our second department,—TECHNICAL CHEMISTRY. Here will be described the practical applications of the processes, formulæ, or chemical agents, which the labours of the purely scientific chemist have placed at the disposal of the manufacturer. In the department of Agricultural Chemistry especial care will be taken to place before the agriculturists of the United Kingdom all the most interesting and useful information to be derived from Home or Continental sources, or from the States of America.

PHARMACY, TOXICOLOGY, &c. next follow, and the Medical Profession will here find from time to time everything of interest relating to Pharmacy, Materia Medica, and Toxicology. Discussions upon Medical Reform and Jurisprudence will also be freely admitted into these columns.

In inviting the support also of the important body of Chemists and Druggists, we offer them our strongest assurance that whatever information may be deemed useful to them, or to their apprentices and assistants, will be duly recorded from week to week; at the same time the Journal will be open to all useful discussions bearing upon their interests and canvassing their grievances, and in this respect it is hoped that the CHEMICAL NEWS will be looked upon as the especial organ of the extensive and important body of Pharmaceutists.

THE PROCEEDINGS OF THE VARIOUS LEARNED SOCIETIES in which the readers of the CHEMICAL NEWS may be supposed to take particular interest, such as the Chemical and Pharmaceutical Societies, will next be given; which will be followed by NOTICES OF BOOKS, PATENTS, &c. under which head will appear impartial criticisms of the more important works of a scientific

or technical character, and abstracts of recent chemical patents.

The Correspondence department will be of a more general character; and, as far as space will permit, this part of our Journal will be freely open for the discussion of all matters relating to any subject of general or particular scientific interest. It must however be borne in mind that a scientific journal is not the proper medium for discussions which overstep the bounds of calm philosophical reasoning; and therefore all personalities will be rigidly excluded. Under this heading will also appear *Chemical Notices from Foreign Sources*, in which either a full or brief abstract will be given of all important chemical papers published abroad. It will be our object to render this branch as complete as possible, so that the careful reader of the Chemical News may really be kept *au courant* with the progress of continental research.

The next departments, viz. Scientific Notes and Queries and Laboratory Memoranda, cannot fail to become of the greatest value to many who may desire to overcome difficulties or elucidate facts for the benefit of themselves and their fellow-labourers in the field of Science; for it cannot fail to have been remarked how vast a number of interesting facts of daily occurrence in a laboratory of research are lost to the world, owing to the want of a readily accessible medium of intercommunication, in which such *Laboratory Notes* could find a convenient record. This department will therefore contain observations and inquiries relating to all branches of Chemical Science; and by thus offering students and practical men facilities for the interchange of their ideas and the communication of improvements and discoveries, the Chemical News will necessarily become a most important stimulus to the diffusion and advancement of scientific knowledge.

In the section following—Miscellaneous—will be given such notices, abstracts, or quotations from our contemporaries or other sources, as do not properly belong to any of the above departments; and under the concluding heading will be given Answers to Correspondents. In this branch great care will be taken to reply to correspondents who may require information upon any subject within the province of this Journal, and they are invited to look upon the Chemical News as a most willing monitor.

The Chemical News will be especially valuable when bound and kept in a convenient position amongst other scientific works of reference. Its value will therefore depend in some measure upon the accuracy and copiousness of its Index, and particular attention will consequently be paid to render it as complete as possible in this respect.

We have now sketched our programme. Each section has been the subject of careful consideration; and the different departments have been arranged with a view to present such a variety as might be thought likely to give the greatest satisfaction to our readers; at the same time we do not pledge ourselves to a strict adherence to any of the above sections; it is very possible that the experience of a few months may show that modifications either in addition or curtailment are desirable, and it would therefore be unwise to bind ourselves to an inflexible rule of action. The editorial staff of writers and contributors is of the most varied and talented description, and it will be the constant endeavour of every one connected with this Journal to render it both truly and honestly deserving of the title under which it is now ushered into the world—The Chemical News.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Vapour Volume, by C. Greville Williams.

Of all the questions now argued among chemists, there is none of more paramount importance for the development of theory than that of vapour volume. It has been common to consider three degrees of condensation as obtaining among chemical substances, namely, to one, two, or four volumes. As an illustration of the first, may be mentioned oxygen, atomic weight = 8: of the second, hydrogen = 1, and of the third, olefiant gas = C_4H_4. But it is plain as regards these relations there is no absolute datum to start from—no unchangeable law of nature round which, as a centre, all our ideas of vapour volume must rotate. Thus the advocates of the unitary system, by raising the atomic weight of oxygen to 16, double its volume, and consider it, in the state of vapour, to occupy the same space as hydrogen. Nevertheless, disregarding, for the purpose of this discussion, the question of the vapour volumes of the elements, a question which can without much difficulty be answered for all practical purposes by the advocates of either system, we go at once to the point by asking, "Is there any amount of gaseous condensation which must be regarded as universally obtaining with organic and inorganic compounds?" In our illustrations we shall use the old notation, not that by so doing we wish to imply a belief in its being more correct than the numbers adopted in the unitary notation, but simply because it is submitted that, as no final argument, no crucial experiment can be brought to bear with overwhelming force upon the side of either theory, it were safer to adhere to the old until further researches have shown its fallacy.

The questions at issue resolve themselves into two, namely:—

1. "Do all compounds undergo a condensation to four volumes?"

2. "Can one atom of a substance contain one equivalent of oxygen = 8?"

Chemists have been, for half a century, reproached with a violent tendency to dogmatise upon doubtful points. They have also been reproached with the circumstance, that not only since chemistry has been a science have there always been two or more theories contending for the mastery,—but, which is far worse, the rival theories are often equally balanced in the scales of argument, and, still oftener, rival theories are discovered to be capable of reigning harmoniously together. As an instance, let us remember the theories of radicals, substitutions and types.

It somewhat unfortunately happens that in answering the above two questions, it is not indifferent which we begin with! for if we decide that all compounds condense to four volumes, and four volumes only, then we are constrained to admit that an equivalent of oxygen = 8, may exist in one atom of a substance, and consequently, that the lower atomic weight must be received. If, on the other hand, we assert that one atom of a substance cannot contain one atom = 8 of oxygen, then we must admit of eight volume formulæ.

But it will be more profitable to see what bearing facts have upon the questions at issue.

In the first place numerous substances have been investigated which have only half the density which would be expected in the event of their condensing to four volumes. It would appear, therefore, that they

possess eight volume formulæ. Among them some of the most prominent and best ascertained are perhaps the following.

Substance.	Density of Vapour.		
	Experiment.	Theory, 4 Volumes.	Theory, 8 Volumes.
Sal ammoniac . . .	0·890	1·850	0·925
Pentachloride of phosphorus	3·654	7·214	3·624
Hydrosulphate of sulphide of ammonium . . .	0·884	1·765	0·882
Hydrotellurate of telluride of ammonium . . .	1·320	2·840	1·420
Hofmann's new base . .	2·260	4·620	2·310
Tetrethylammonium iodide.	. .	8·890	4·445

It is unnecessary to add more examples, because the above contain all the features requisite to enable us to discuss the cause of bodies only condensing to eight instead of four volumes.

Most of the substances mentioned above may be considered to undergo decomposition at the elevated temperature at which the experiment is made, the result being that the balloon, instead of containing one vapour of anomalous expansion, contains *two vapours*, each asserting its individuality as a four volume gas. As soon, however, as the balloon cools, the two gases unite to reproduce the original substance. Thus we may assume the following diagrams to represent the contents of the balloons at the temperature of vaporisation.

I.

NH_3= 4 vols.	HCl= 4 vols.

8 vols. of NH_4Cl.

II.

PCl_5= 4 vols.	Cl_2= 4 vols.

8 vols. of PCl_5.

III.

NH_3= 4 vols.	2 HS= 4 vols.

8 vols. of NH_4S, HS.

IV.

NH_3= 4 vols.	2 TeH= 4 vols.

8 vols of NH_4Te, TeH.

V.

$C_{12}H_{16}N_2$= 4 vols.	2 HO= 4 vols.

8 vols. of new base.

VI.

$C_{12}H_{13}N$= 4 vols.	CH_3I= 4 vols.

8 vols. of iodide of tetrethylammoninm.

Whatever may be the true nature of the phenomena in the third and fourth cases, it is certain that bodies sometimes break up in the heated balloon in the manner indicated, and on cooling regain their former condition. For example, Hofmann has found that the iodide of tetrethylammonium breaks up when heated into four volumes of triethylamine and four volumes of iodide of ethyle, but, on cooling, the two bodies re-unite to form the original compound. In proof of this it may be mentioned that if the iodide of the ammonium base be distilled *into water*, the triethylamine dissolves and the iodide of ethyle settles to the bottom. Reactions will one day appear, proving the nature of the decompositions which take place with the other examples given. In fact the dioxide of Hofmann's new diammonium base splits up under certain conditions which indicate that 8 volumes of its vapour certainly consist of four volumes of an alkaloid plus four volumes of water vapour.

The above illustrations suffice to show that both in organic and inorganic chemistry substances exist which in the state of vapour occupy twice the volume of the majority of bodies. But, on the other hand, what shall we say where the compounds for the same metal occupy two volumes in one, and four volumes in the other class of salts? This actually happens with the chlorides and bromides of mercury, as will be seen from the following table.

Substance.	Density of Vapour.		
	Experiment.	Calc. 4 Volumes.	Calc. 2 Volumes.
Mercuric iodide, HgI. . .	15·90	. .	15·708
Mercuric bromide, HgBr. .	2·16	. .	12·456
Mercuric chloride, HgCl. .	9·80	. .	9·377
Mercurous bromide, Hg_2Br.	10·14	9·68	
Mercurous chloride, Hg_2Cl.	8·35	8·14	

From the above results we are forced to admit that in mercuric and mercurious salts the vapour volume is just that of the metal or chlorine, &c. and the vapour volume of one of the elements becomes altogether lost. It would perhaps be a violent inference to conclude the true atomic weight of the metal to be 200 = 4 volumes. This, however, would have the effect of giving all these salts of mercury the same condensation, namely to four volumes. We should then of course have to use the old nomenclature and say biniodide, bichloride of mercury, &c. It is probable that the convenience of removing the above substances from the anomalous position of having two vapour volumes, would be at least as great as the inconvenience of giving a metal a 4 volume equivalent.

The chlorides of bismuth, antimony, and arsenic give 4 volume; and the chlorides of tin, titanium, and silicon 2 volume formula. But then, if the same rule holds here that we have seen with the compounds of mercury, we might say that this is because the former are *ous* salts, whereas the latter are fully saturated with chlorine. As regards bismuth, we do not know of a higher chloride that $BiCl_3$; whereas with antimony and arsenic, we know that compounds with five atoms of the electronegative body exist. Their vapour densities have not, however, been determined. Probably they will decompose in the manner we imagine pentachloride of phosphorus to do, the result of course being an augmentation of volume.

From what has been said, it is evident that, however we may desire to find a universal unit of volume for compound gases, either organic or inorganic, it is impossible to lay down any law until further researches have been made. One set of reactions are often in favour of certain views, while another of no less importance appear to force us to diametrically opposite conclusions. As one example among many, let us cite the controversy respecting the atomic weight of silicon, the vapour densities of the chloride and fluoride leading to one formula, while the difference between the boiling points of the chloride and bromide points to another. With regard to the second question, we shall be very brief. If it can be shown that four volumes of any substance (and four volumes representing an equivalent) contain one equivalent (= 8 parts) of oxygen, then all the theories which, under the name of the unitary system, have been built upon the foundation of O, having an atomic weight of 16, will fall. Nevertheless, Bruning has obtained a substance by acting on iodoform with potash, which certainly appears to contain C_2HI_2O = 4 vols. Experiment gives for the vapour density 9·55. Theory requires 9·515. As it is probable that some other chemists have discovered bodies having one equivalent of oxygen for four volumes of vapour, but have rejected their experiment from fear of appearing heterodox, it is hoped that such experiments may be brought to light, with a view of discussing their merits.

The above has been written with the hope of calling the attention of those chemists who have hitherto neglected the subject of vapour volume to the importance

of accumulating and publishing data from which conclusions can be drawn.

Before ending this notice, it is desired to put into the hands of students the following excessively simple and easy method of calculating vapour densities from atomic weights. It is the shortest that can possibly be used, as it only requires one multiplication; moreover, the results are perfectly accurate, as they solely depend on the density of hydrogen, a datum which has been determined with extreme precision.

To obtain the density of a vapour or gas having a *one* volume formula, such as oxygen (equiv. 8); multiply the atomic weight of the gas or vapour by twice the density of hydrogen = 0·1384.

If a *two* volume formula, multiply by the density of hydrogen = 0·0692.

If a four volume formula, multiply by half the density of hydrogen = 0·0346.

If an eight volume formula (*e.g.* PCl_5), multiply by one quarter the density of hydrogen = 0·0173.

It is evident that, in order to obtain the atomic weight from the vapour density, it is only necessary to divide the latter by the density of hydrogen, or a multiple or sub-multiple of it, according as we have a one, two, four, or eight volume formula to deal with.

On a New Process for preparing certain Chlorinated Derivatives of the Benzole Series, by ARTHUR H. CHURCH, *F.S.C.*

MONOCHLORINATED benzole, or chloride of phenyle $C_{12}H_5, Cl$, has been obtained by the action of pentachloride of phosphorus on hydrate of phenyle; while the next term of the series, chloride of toluenyle, $C_{14}H_7, Cl$, is formed when toluole is distilled in a stream of chlorine. The higher homologues of these bodies have not been obtained as yet; and while both the methods mentioned above are somewhat uncertain in their results, the latter process is not applicable in all cases. A new plan of procedure was therefore much to be desired, and that which I have now to mention seems, so far as I have tried it, to promise the best results: and I think it is applicable to hydrocarbons other than the homologues of benzole, to olefiant gas, for instance.

Finely powdered bichromate of potassium is to be introduced into a flask, together with sufficient water to moisten the salt; considerable excess of hydrochloric acid is then to be poured in. The flask must be placed in a sand-bath, and heated till a slight evolution of chlorine occurs; the hydrocarbon is now poured upon the surface of the mixture, while a perforated cork, in which a long piece of combustion-tube has been mounted, is inserted in the neck of the vessel to serve as a condenser for the hydrocarbon. The green colour of the chlorine is never visible, for the hydrocarbon absorbs every trace. The chromic solution is rapidly reduced, and the process is generally complete after a few hours heating of the mixture at a gentle heat. The hydrocarbon becomes less and less volatile, and also less and less mobile, until none of it remains unacted upon. The mixture is now allowed to cool, and the oily layer on the surface removed by the pipette. After having been washed with hydrochloric acid, with aqueous potash, and with water, it may be dried by means of chloride of calcium, and then heated to separate any traces of the original hydrocarbon. The chlorides of phenyle and toluenyle may be distilled without change; the chlorides of xylenyle and cymenyle, which I have prepared in some quantity, suffer decomposition when heated beyond 200° C. The chloride of xylenyle is an aromatic oil of pleasant odour (it was made with pure xylole from coal naphtha), and it boils at about 216° or 218°; but at this temperature it already begins to evolve hydrochloric acid. Unlike the original hydrocarbons, all these chlorides are considerably heavier than water, but they float upon a saturated solution of common salt. A rough experiment gave 1·135 as the specific gravity of chloride of xylenyle, while that of the chloride of cymenyle is nearly 1·146; these numbers are probably a little too high.

Now that these chlorides may be easily obtained in any quantity, I intend to study their reactions and transformations in detail. I have already prepared the cyanide of xylenyle by the action of cyanide of potassium upon the chloride. The cyanide is a disagreeably-smelling oil heavier than water, which, when heated with an alcoholic solution of potash, yields ammonia, and the potassium salt of an organic acid, probably a new acid, the xyloic: the reaction may be thus expressed:—

$$\underbrace{C_{10}H_9, C_2N}_{\text{cyanide of xylenyle.}} + KO, HO + 2\,HO = \underbrace{C_{18}H_9KO_4}_{\text{xylate of potassium.}} + NH_3$$

The action of hydrate of potassium in this transformation is very slow; even after several hours digestion much of the organic cyanide remains undecomposed. Cannizarro has already obtained toluic acid by a precisely analogous transformation. The chloride of cymenyle should yield cyminic acid, $C_{22}H_{14}O_4$, in the same way. When this chloride is distilled with dry carbonate of ammonium, it yields an oily organic base, presenting all the characteristics of cymidine.

In giving this slight sketch of a process by which the proto-chlorides of certain organic radicals may be obtained, I reserve further details for a second communication. There is one point, however, of some interest connected with these experiments that it may be well to mention here. If the hydrocarbon to be chlorinated be poured upon the chlorine mixture before the evolution of chlorine has actually commenced, considerable quantities of oxidised acid products are obtained. In this way xylole yields, among other compounds, toluic acid, while with cymole cuminic acid is formed.

Lincoln College, Oxford, Dec. 6th, 1859.

On the Separation of the Oxides of Nickel and Cobalt from Peroxide of Iron, by FREDERICK FIELD.

IN the year 1857, I published a short paper in the *Chemical Gazette* on the separation of oxide of manganese from oxide of iron by means of oxide of lead. It was remarked, that although the separation was satisfactory, sulphuretted hydrogen had to be employed to precipitate small quantities of lead from the manganese solution, even after the addition of sulphate of soda. Subsequent experiments have proved, however, that if dilute sulphuric acid be used there is no difficulty of the kind, and the oxide of manganese can at once be precipitated by potash. The same is the case with the precipitated peroxide of iron and the excess of oxide of lead. When these precipitates are digested in weak nitric acid and sulphuric acid, or a soluble sulphate added, it can easily be supposed that the whole of the lead is not thrown down; but if they are digested in dilute sulphuric acid, no lead can be detected in the solution of the persulphate of iron. It is necessary to avoid as much as possible the presence of hydrochloric acid, as that body, as is well-

known, decomposes sulphate of lead. The separation of oxide of cobalt, or oxide of nickel, from oxide of iron, can be determined with equal facility by the same method.

In the case of nickel and iron, the nitrates are evaporated nearly to dryness, and after the addition of water, oxide of lead (litharge) is added, and the whole boiled for ten minutes or a quarter of an hour. The iron is entirely precipitated, the nitrates of nickel and lead remaining in solution. After filtration, which can be effected with great readiness, dilute sulphuric acid is added, and on standing for sixteen hours, the sulphate of lead is filtered off, and the nickel precipitated and estimated in the usual manner.

The filter containing the peroxide and excess of litharge is digested in dilute sulphuric acid, filtered and washed. The filtrate is precipitated by potash.

10·00 grains of pure iron dissolved with 5·00 grains of nickel gave 14·22 Fe_2O_3 and 6·41 NiO. (Calculated 14·29 Fe_2O_3 and 6·43 NiO.)

5·00 grains iron and 10·00 grains nikel gave 7·12 Fe_2O_3 and 12·81 NiO. (Calculated 7·145 Fe_2O_3 and 12·86 NiO.)

It may here be remarked that oxide of nickel can be more readily determined by precipitation as *peroxide*, by means of hypochlorite of soda than as oxide by caustic potash. Peroxide of nickel, after boiling the solution in which it is suspended, separates as a rather dense precipitate, and can be easily washed, whilst the great difficulty of freeing the potash from the bulky gelatinous protoxide is well known. The alkali, indeed, adheres with remarkable pertinacity to this substance, and if not added with considerable caution, and other circumstances attended to, very protracted washing is necessary.

In employing the hypochlorite of soda, it is requisite to have an open vessel, a beaker for instance, as the peroxide is liable to form flakes upon the sides of the glass, which are difficult to remove from a narrow-necked flask. The peroxide is heated to whiteness, and the nickel weighed as protoxide.

Cobalt can be separated from iron in precisely the same manner as nickel. Many analyses have shown that no trace of cobalt is precipitated from its solution on boiling with oxide of lead, and even when the iron is in considerable excess, 50 to 1 for example, the separation is complete.

The solution of cobalt freed in this manner from iron, contains no trace of that metal, gives no shade of blue with ferrocyanide of potassium, nor can iron be recognised by any known test.

In conclusion, the separation of the oxides of nickel and cobalt from iron can be effected with equal accuracy by oxide of lead, as by carbonate of baryta, and the operation is speedier, as a few minutes brisk ebullition is sufficient. The oxide of lead, with ordinary care, can be removed as easily from the solution as the baryta, by means of sulphuric acid.

TECHNICAL CHEMISTRY.

On Platinum and its associated Metals, by MM. Deville *and* H. Debray.

The *Annales de Chimie et de Physique* for August last contains a very elaborate article by the above chemists on the subject of platinum and the metals which accompany it. The results at which they have arrived are so important, and they are moreover of such interest, that we are induced to lay before our readers a few of the principal facts contained in their memoir.

The metallurgy of platinum is altogether a modern art, the introduction of the metal into the laboratories of science and industry dating but from a few years back; and although particularly deserving the attention of the chemist, the metallurgy of platinum and its congeners is, in general, but little known. Except for chemical purposes, platinum has not hitherto received any important application; but when we know better where to look for its ores, and when the deposits already known are more extensively worked, the ores of platinum will, perhaps, become no rarer than gold; and as the metal is almost indestructible, and as its value protects it from losses and accidents of all kinds, it must in time accumulate and thus become more plentiful. It may then perhaps be applied to other useful purposes in which its weight and slightly tarnished colour will be no objection, or for which its absolute unalterability will give it a peculiar value. The solution of these questions, however, depends on the price for which the metal can be supplied; and the chemist is particularly interested in seeing its cost so far reduced that the large vessels of the laboratory may be made of platinum. It was in the hope of facilitating a progress of this kind, that MM. Deville and Debray undertook the difficult researches the results of which are given in the above-mentioned memoir, a work which has cost them more than four years of labour.

Until the first communications of M. Deville were published no one dreamt of utilising all the metals found with platinum, and with the exception of palladium and osmium, which there was always a motive for separating, platinum alone has been extracted from the ores, leaving a residue which has accumulated in all the manufactories in Europe as well as in the Russian Mint.

The processes described are exclusively by the dry way, and by fusion at a very high temperature. They are given in different chapters, which treat of "the revivification of pure platinum," "the metallurgy of pure platinum," "the extraction from the rough ore of a triple alloy of platinum, rhodium, and iridium of a suitable and invariable composition;" and lastly, the extraction, whether from the residues or from the osmide of iridium, of the utilisable metals, platinum, paladium, rhodium and iridium.

We give first, the methods practised for obtaining pure platinum, reserving for a future occasion the interesting accounts of the individual metals, and the methods for essaying the rough ores and residues.

In commerce, platinum is found which is almost free from iridium, but which still contains traces of osmium and a little silicium. MM. Deville and Debray have discovered that fusion in lime by means of an oxidising flame, refines it perfectly, osmic acid being disengaged, and the silicium becoming converted into silicate of lime, which melts into a colourless bead, and moves rapidly about on the surface of the metal until it reaches the edge, where it is absorbed by the sides of the furnace. Platinum so melted and refined is a metal as *soft* as copper; it is whiter than ordinary platinum, and does not possess the porosity which has hitherto been an obstacle to the manufacture of an impermeable platinum sheath.

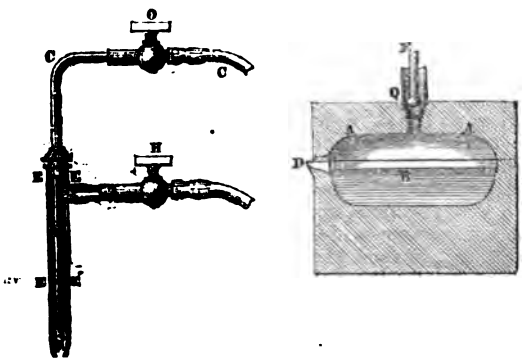
Melted platinum still possesses the property of condensing gases at its surface, and of producing the phenomenon of a lamp without flame. Its density = 21·15—less than the density of ordinary platinum which has been subjected in the working to a powerful hammering (*d'un écrouissage extrêmement énergique*).

We now proceed to describe the apparatus by means of which platinum has been melted, in quantities relatively

considerable, and run into ingots, like a metal of ordinary fusibility.

The fuel most often employed has been common coal-gas, but hydrogen may be used, and when pure will give even a greater heat. The combustion is fed by a current of oxygen. The furnace in which the fusion is made, is of lime bound with iron wire. It is composed of two parts: 1. the roof A A, made of a cylindrical piece of lime slightly arched on its lower surface, and pierced by a conical hole O, through which a blowpipe C E is to pass: and 2. a bottom B, made of another piece of lime, hollowed as shown in the diagram. The hollow should be scooped out so deep, that the melted platinum may occupy a depth of 3 or 4 millimetres or more. At the anterior part D, a groove inclined a little towards the inside is made with a file, which is to serve as a hole for the metal to run out of and for the flame to issue from.

The blowpipe is composed of a copper cylinder E E, terminated at its lower extremity by a slightly conical



tube E′ E′, made of platinum. A copper tube C C C, having a platinum nozzle, enters the first cylinder at its upper extremity, and is so arranged as to allow the nozzle to be slid up or down, and placed at any height from the lower end of the cylinder E E E′ E′, that may be wished.

A stopcock H, is attached to the side of the cylinder F, by means of a tube as large as the cylinder itself. Another stopcock O, terminates the elbow of the tube C. It is by the stopcock H, that the hydrogen or coal gas passes, and the oxygen is introduced through the stopcock O.

When the fusion is to be made, the pieces of lime composing the furnace are put together in the way represented in the diagram. Then, holding the blowpipe in the hand, the stopcock H is opened so as to allow the passage of a gentle stream of gas which is lighted, and the stopcock O is turned to admit the oxygen necessary for the combustion. The flame is in this way plunged into the apparatus by the hole O, in such a manner as to avoid an explosion, which might disturb the pieces of lime. The body of the furnace is now gradually heated; the quantity of the gases passing being increased by degrees until the maximum temperature is attained. The degree of heat may be raised or lowered as need be, by raising or lowering the platinum nozzle which supplies the oxygen. The temperature is now lowered, and the platinum is introduced, by little and little, through the opening D. When it is in thin slips of less than a millimetre in thickness there is scarcely time to introduce them. They are seen to melt and disappear almost at the moment they enter the furnace. The oxygen should arrive at a regular pressure of about four or five centimetres of mercury, and ought to give a rotatory movement to the platinum so as to equalise the temperature throughout the mass.

When it is not wished to run the metal into a mould, the fusion being perfect, and the refining completed, which is the case when no more vitreous matter is seen to form on the surface, the two gases are turned off by degrees, always leaving the oxygen in a decided but very slight excess. The mass now gradually solidifies, and the flame may be completely extinguished. A little of the metal is always thrown up to the roof of the furnace, where it may be easily collected after the operation is finished.

When the platinum is to be cast, an ingot mould is prepared of thick cast iron, well rubbed with plumbago, or of coke or lime. The last are most easily made of plates of the substance, sawn, and held together by iron wire. The roof of the furnace is taken off, the body seized with a pair of tongs, and the platinum is poured out, without hurrying, just as we should any other metal. The only difficulty which occurs, and this a little practice will enable the operator to overcome, is to discern at the same time the dazzling surface of the metal and open mouth of the mould, before turning up the crucible. A larger quantity than 3 or 4 kilogrammes should never be cast in this way, inasmuch as there would be great danger of some part of the apparatus giving way.

For greater quantities, the authors describe how a larger furnace may be made of several pieces of lime bound firmly together with iron; and an ingenious and simple arrangement, by means of which the metal may be poured out without taking up the bottom part of the apparatus. The reasons they give for preferring to use lime in the construction of the furnace are as follows:—

1. Lime is perhaps the worst conductor of heat known; so much so, that through a thickness of at most 2 centimetres (0·8 inch), the apparatus being full of melted platinum, the temperature of the outside is barely 120° (Cent.).

2. Lime radiates heat most perfectly. For this reason it is the best material for the sides of a reverberatory furnace of this kind.

3. Lime acts on all the impurities from which we wish to free platinum — iron, copper, silicium, &c. changing them into fusible compounds which are absorbed by its porous substance. It acts like a cupel, the material purifying the metal melted in it.

An experiment made in the laboratory of the *Ecole Normale* showed that the quantity of oxygen required to melt 1 kilogramme (2·2 lbs. Avoird.) of platinum was only 60 litres (about 13 gallons), the cost of which was estimated at 0·4 of a franc. The cost of the coal gas or hydrogen used was not considered worth taking into account.

The process applied to the revivification of old platinum gives excellent results. No foreign metal except iridium and rhodium can exist in platinum after it has been melted and refined in the method described. All the substances which most easily attack platinum, sulphur, phosphorus, arsenic, gold, soda, iron, copper, palladium, and osminum, are separated either by oxidation and absorption by the lime or by volatilisation. Gold and palladium escape in the form of vapour, and may be easily collected by making the flame which issues from the furnace pass through an earthenware tube, in which will be deposited all the volatile matters except the osmic acid, which may be condensed if the vapour is made to pass over a vessel full of ammonia. A part of the osmium is also deposited in the tube in a metallic state.

The only caution to be observed in the process is never to have the bath of metal of more than 4 or 5 centi-

metres thickness without keeping it in constant agitation; because the platinum is too bad a conductor to remain perfectly liquid if it is in greater depth; and, therefore, there will be a chance of the refining not being complete, or of the perfect fusion of the mass not being quite effected.

On the Employment of Carbon as a means of Permanent Record, by John Spiller, *F.C.S., of the War Department.*

The undoubted superiority, in respect to the quality of permanence, of ordinary printed characters in comparison with the several kinds of manuscript, renders it desirable that efforts should be directed to the possibility of availing ourselves of the unalterable nature of carbon, the principal ingredient in printer's ink, with a view to the employment of the same as a substitute for the tannate of iron in the ordinary black writing fluids. The want of permanence constantly attributed to the latter, and borne out by the inspection of manuscript deeds of comparatively recent date, seems inherent to an ink which depends solely for its permanence on a weak chemical affinity exerted between the oxides of iron and the product of a vegetable infusion, which, left to itself, is constantly undergoing change. Hence the application of dilute acids, both mineral and organic, is sufficient either to obliterate or render illegible the characters written with such ink; while its composition makes it liable to fade under circumstances no more unfavourable than that of exposure to a damp or impure atmosphere.

On the other hand, the imperishable nature of carbon, in its various forms of lamp black, ivory black, wood charcoal, and graphite or black lead, holds out much greater promise of being usefully employed in the manufacture of a permanent writing material; since, for this substance, in its elementary condition, and at ordinary temperatures, there exists no solvent nor chemical reagent capable of effecting its alteration. Carbon is destroyed, or rather oxidised, only by fire, and by the long continued action of the strongest acids; only under such circumstances, therefore, as the tablet of prepared vegetable or animal substance is itself unable to withstand. Provided, then, that sufficient means can be adopted for securing its perfect adhesion to the surface, or passage even into the pores, of the paper (a point not sufficiently considered, perhaps, in the production of the so-called permanent carbon photographs), there seems every probability of a carbon pigment resisting the effects of time and other corrosive influences better perhaps than any other substance, elementary or compound, which is likely to be brought into comparison with it. The perfect state of preservation of the early engravings and pages of printed type corroborates this view; they exhibit in some instances evidence of destruction by decay of the paper itself, rather than that of the carbonaceous material forming the subject of the picture.

The suggestion relative to the mode of applying carbon to these purposes, which it is intended more particularly now to enunciate, depends on the fact of the separation of carbon from organic compounds, rich in that element, sugar, gum, &c. by the combined operation of heat and of chemical reagents, such as sulphuric and phosphoric acids, which exert a decomposing action in the same direction; and by such means to effect the deposition of the carbon within the pores of the paper by a process of development to be performed after the fluid writing ink has been to a certain extent absorbed into its substance. A system of formation by which a considerable amount of resistance, both to chemical and external influences, appears to be secured. An ink of the following composition has been made the subject of experiment:—

Concentrated sulphuric acid, deeply coloured with indigo . . .	1 fluid ounce.
Water	6 „ „
Loaf sugar	1 ounce troy.
Strong mucilage of gum arabic .	2 to 3 fluid ounces.

Writing traced with a quill or gold pen dipped in this ink dries to a pale blue colour, but if now a heated iron be passed over its surface, or the page of manuscript held near a fire, the writing will quickly assume a jet black appearance, resulting from the carbonisation of the sugar by the warm acid, and will have become so firmly engrafted into the substance of the paper as to oppose considerable difficulty to its removal or erasure by the knife. On account of the depth to which the written characters usually penetrate, the sheets of paper selected for use should be of the thickest make, and good, white, cartridge paper, or that known as "cream laid," preferred to such as are coloured blue with ultramarine, for in the latter case a bleached halo is frequently perceptible around the outline of the letters, indicating the partial destruction of the colouring matter by the lateral action of the acid.

The writing produced in this manner seems indelible; it resists the action of "salts of lemon," and of oxalic, tartaric, and diluted hydrochloric acids—agents which render nearly illegible the traces of ordinary black writing ink; neither do alkaline solutions exert any appreciable action on the carbon ink. This material possesses, therefore, many advantageous qualities which would recommend its adoption in cases where the question of permanence is of paramount importance; but it must, on the other hand, be allowed that such an ink, in its present form, would but inefficiently fulfil many of the requirements necessary to bring it into common use. The peculiar method of development rendering the application of heat imperative, and that of a temperature somewhat above the boiling point of water, together with the circumstance that it will be found impossible with a thin sheet of paper to write on both sides, must certainly be counted among its more prominent disadvantages.

Though not perhaps capable of employment on the animal tissues, vellum and parchment, there is every probability of its successful application in connection with the new material produced by the action of strong acids on paper, and known under the name of vegetable parchment.

Royal Arsenal, Woolwich, Dec. 5th, 1859.

PHARMACY, TOXICOLOGY, &c.

Researches on Colocynth, by M. Walz.

M. Walz has separated from colocynth:—

1. Colocynthine C_{56} H_{82} O_{32} a glucoside.
2. Colocynthidine.
3. A resin soluble in ether.
4. A resin soluble in alcohol.
5. Colouring matter soluble in alcohol.
6. Colouring matter soluble in water.
7. Gum and mucus.
8. A liquid fatty matter.

The first is prepared in the following manner: Colocynth pounded is exhausted by alcohol. The product is evaporated to dryness in a water bath, and is then

treated with water. To this aqueous solution are added some neutral acetate and basic acetate of lead, and the liquid is filtered. The filtered liquid is yellow. The excess of lead is now removed by passing a current of sulphuretted hydrogen through the liquid, and afterwards a solution of tannin is added: a precipitate is formed which, when boiled in the mother liquor, acquires a resinous consistence. It is well washed with water, and then dissolved in alcohol: acetate of lead is added to remove the tannin, and it is then digested with animal charcoal. The golden yellow liquid obtained gives on evaporation a yellow powder, which is purified by ether. This is pure *Colocynthine*. The residue left, after treating the alcoholic extract with water, contains the *Colocynthidine*. It is soluble in ether, and so may be extracted with this menstruum. The solution is decolorised by animal charcoal, and evaporated to dryness. The residue is dissolved in absolute alcohol, from which the colocynthidine slowly crystallises out in white rhomboidal prisms.

The seeds contain less of this latter substance than the fleshy part of the fruit; but in its stead is found a very bitter oil, which communicates its bitterness to water.

Pure colocynthidine forms a bright white powder, composed of microscopic prisms. It is nearly insoluble in cold, but dissolves readily in boiling alcohol, from which part of it separates in crystals on cooling. The remainder forms a gelatinous solution, which will not crystallise for some time.

The aqueous solution of *Colocynthine* is decomposed almost instantaneously in the presence of dilute sulphuric acid, and forms a white precipitate which becomes resinous on boiling. This product, which the author calls *Colocyntheine*, has the formula $C_{44}\,H_{28}\,O_{18}$; the other product is a Carbohydrate, of the formula $C_{12}\,H_{10}\,O_{10}$. M. Walz considers it cane sugar. — *Neues Repert. der Pharm.* Bd. vii. S. 371.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, *December 1, 1859.*

Professor B. C. Brodie, *F.R.S. in the chair.*

A paper was read by Mr. Perkins, *on the Action of Pentachloride of Phosphorus on Tartaric Acid*, by which a volatile product is obtained having the composition $C_8\,H_2\,Cl\,O_8$, and named para-maleic acid, and from this Messrs. Perkins and Duppa prepared and examined several salts. Dr. A. W. Hofmann then made a statement relative to certain discrepancies observed in the determination of the vapour densities of organic bodies. Referring to the several products obtained by Clauss through the action of ammonia on the bromide of olefiant gas, Dr. Hofmann stated that some of these were found to occupy, in the form of vapour, eight volumes instead of the four usually presented by bodies of the same class. Taking the particular instance of one of the derivatives constituted like the oxide of ammonium, he had found it impossible by any of the ordinary processes, as distillation from caustic potassa, to remove one equivalent each of oxygen and hydrogen in the form of water; but he was nevertheless compelled to consider this body as a hydrate, because sodium disengaged from it hydrogen gas. Preparing by virtue of this reaction the anhydrous substance, Dr. Hofmann found its vapour-density to be now equal to four volumes; hence he was led to the conclusion that the vapour of water, occupying itself four volumes, presented a clue to the solution of the difficulty.

A discussion followed, in the course of which Dr. Odling pointed out other examples in the chlorides of ammonium and mercury, which occupy in the state of vapour eight volumes, or the sum of that presented respectively by the ammonia and hydrochloric acid considered as separate constituents of the first; and, in the latter example, that of chlorine in addition to the space occupied by the vapour of mercury.

Dr. Hofmann then proceeded to describe an arrangement of apparatus which, with the assistance of Professor Buff, he had devised for readily demonstrating at lectures the decomposition of compound gases by the passage of the electric spark. It consisted of a Rühmkorff coil, connected with the platinum wires of Ure's eudiometer tube, arranged so that a rapid succession of sparks might be directed through a volume of gas confined in the closed limb of the instrument. Dry ammonia gas was shown by experiment to be quickly resolved into its constituents, which then occupied the double volume. The compensation for increasing pressure was regulated by the adaptation of an exit tube to the lower bend of the eudiometer, as suggested by Professor Bunsen, and by which means the level of the mercury in both limbs of the tube might be easily restored. The rapid formation of red nitrous fumes when the sparks were passed through atmospheric air; the decomposition of carbonic acid gas into a mixture of oxygen and carbonic oxide, which, when the separation had reached a certain stage, were again combined with explosion; the production from sulphurous acid gas of anhydrous sulphuric acid with liberation of sulphur; and the reduction of filamentous carbon from both light and heavy carburetted hydrogen were among the most interesting results observed in these experiments.

Professor C. L. Bloxam rose to remark that, in conjunction with Dr. Miller, he had frequently availed himself of the decomposing powers commanded by the Rühmkorff coil as a means of demonstrating to an audience the increased volume of gas resulting from the decomposition of ammonia. The arrangement usually adopted at King's College differed from that exhibited by Dr. Hofmann in the use of a straight eudiometer tube, by adjusting which at the conclusion of the experiment, until the level of the mercury both within and without the tube became the same, the production of a doubled volume was very apparent. He was much struck also with the great facility afforded by this apparatus for the exhibition of the phenomena of ozonification; as also by the very conspicuous manner in which the red nitrous fumes were developed in air, to which an increased amount of pure oxygen had been supplied.

The President then pronounced the meeting adjourned until the 15th inst., for which evening several papers were announced.

PHARMACEUTICAL SOCIETY. *Wednesday Evening, December 7th.*

T. N. R. Morson, Esq., *President, in the Chair.*

Professor Bentley exhibited a large number of beetles which had been found in a sample of cantharides. They exactly resembled cantharides in colour, but not at all in shape.

Dr. Redwood said the occurrence of such an adulteration showed the importance of a knowledge of natural history to the pharmaceutist. A man uninstructed in that science would have passed the sample without discovering the adulteration.

Professor Bentley also showed a few cantharides which had been caught in Norfolk this year. He said their appearance in England was by no means uncommon. They were found in considerable numbers in 1837, but their appearance was always confined to the three eastern counties, Norfolk, Suffolk, and Essex.

A specimen of podophyllin, said to be the active principle of the podophyllum peltatum, was also exhibited. It is a strong cathartic recently introduced into medicine.

A communication from Messrs. E. and T. Smith, of

Edinburgh in praise of their own syrup of iodine of iron was then read. Referring to a paper published in a recent number of the *Pharmaceutical Journal*, they said that the colour of the syrup was no test of its strength. Their own was colourless, and they sent a sample (*in a green bottle*) to prove the fact. If it become coloured they expose it to sunlight for a day, which bleaches it again. To ascertain whether a syrup contained its proper proportion of the iodide, they recommended that the iodine should be precipitated from a measured quantity of the syrup, by means of bichloride of mercury, in the form of biniodide of mercury; and from the weight of this the quantity of iodide of iron in the syrup could be calculated.

In the discussion which followed, a general opinion was expressed that there was no difficulty whatever in the preparation of the syrup, and that it ought always to be of a faint green colour. As to the action of light some difference of opinion prevailed, and a communication from Mr. Williams was read, in which he said, that if air were excluded, light had no effect on the syrup.

The meeting then turned to the discussion of the action of light on things in general, in the course of which, reference was made to a paper published by Sir J. Herschel, in which he stated his opinion that vegetable colours are not affected by the actinic rays, but by the colours complementary to those of the substances; but whether this effect is preservative or injurious it will be impossible to say without a reference to the paper alluded to.

Mention was made of the action of light on hydrocyanic acid, and Mr. Bottle asked which colour was best for preserving it, blue or yellow. His opinion was that yellow was the best.

The Chairman said that bottles were now sold of some inferior glass, which quickly decomposed the acid, and turned it black.

The subject of syrup of ginger was then introduced, and the propriety of varying the process of the London Pharmacopœia for its preparation was discussed.

The Chairman said he thought it would be made best with a solution of gingerine or essence of ginger, and the meeting seemed to acquiese in the opinion.

A paper by Mr. Morland on the presence of arsenic in trisnitrate of bismuth was then read.

Mr. Mohland had examined some specimens of trisnitrate of bismuth, and had only discovered mere traces of arsenic in them. He had, however, found a considerable quantity of subchloride in all. He believed the arseniate of bismuth to be almost insoluble in nitric acid, and therefore a true nitrate was not likely to contain arsenic. The oxychloride, however, might be contaminated with arsenic.

Mr. Huskisson remarked that from the way in which the trisnitrate of bismuth was made, it was impossible that it could contain more than a mere trace of arsenic. In the first place, the metal was roasted, and it was well known that arsenic was volatilised at about 397°. The metal was then digested with nitric acid, and the nitrate formed was crystallised. If any arsenic remained after the roasting, it would be found in the mother liquor of these crystals, which was poured off before the nitrate was treated with water.

The Chairman said he hoped the subcarbonate of bismuth, which he believed to be a much better preparation than the nitrate, would soon come into general use. It was best precipitated with carbonate of ammonia and a little free ammonia, which separated the copper and nickel generally found in bismuth. The best samples of bismuth, he said, contained scarcely any arsenic.

In the course of the discussion it was elicited that the oxychloride of bismuth was commonly sold for the trisnitrate, and that that might contain a good deal of arsenic.

The Chairman then made an important communication to the meeting. In consequence of receiving a letter from a country member, the Council of the Society had been in communication with the Board of Excise, relative to the question of the legality of selling *dandelion coffee* without an Excise licence. The Board had decided that to sell coffee with any admixture was a decided infringement of the Excise laws, and the members were warned accordingly. Dandelion root alone might perhaps be sold *as coffee* without a licence, but the smallest admixture of coffee constituted an infringement of the law. Permission had been given by the Board for a few admixtures of coffee with other substances to be made, and no doubt, if the Council applied, the Board would give druggists permission to make and sell a mixture of the kind, but then it would have to be expressly stated on the label what the mixture was.[1]

A question was raised whether the sale of essence of coffee without a licence was forbidden.

The meeting then adjourned till Wednesday, January 4, 1860.

NOTICES OF BOOKS, PATENTS, &c.

RECENT CHEMICAL PATENTS.

The Aniline Dyes.—Messrs. Beale and Kirkham have patented improvements in the preparation of colours for dyeing and printing. They take a salt of aniline in solution, or a saturated solution of aniline in water, and add thereto an equal quantity, by measure, of acetic acid. To this acid solution, a solution of chlorine or of a hypochlorite, as bleaching powder, is added, when the change of colour takes place and the liquid dye is produced. By varying the proportions and strengths of the materials, a variety of colours and shades may be produced. The liquor thus obtained may be used at once to dye blue; but if it be kept for a few hours it will dye purple and lilac. The dye after the exhaustion of one colour may be used for others, from blue, violet, and lilac, down to slate, brown, and straw, by the addition of more or less chlorine or hypochlorite. The proportions given are one measure of saturated aniline water, one measure of acetic acid, of five strengths, and one measure of hypochlorite of lime, sp. gr. 1010. The last must be added carefully to produce the shade of violet blue required. Instead of using the hypochlorite, chlorine may be passed through the acid solution of aniline, it being carefully watched in order that the supply of gas may be arrested when the required effect has been produced. Or, take one measure of hydrochlorate of aniline, sp. gr. 1010, one measure of acetic acid, and one measure of hypochlorite of lime, sp. gr. 1010, the last being carefully added in small quantities as before. This will produce a violet blue dye, and after a time lilacs, just as the former.

The above dyes may be used for silks without mordants.

Red Dyes.—Mr. Brooman has also obtained a patent for improvements in the preparation of red dyes. The inventors boil for fifteen or twenty minutes a mixture of aniline and anhydrous bichloride of tin At first the mixture assumes a yellow, then a reddish tint, and finally changes to a beautiful red. The mixture is liquid while hot, but when cold becomes gelatinous. The gelatinous mass is boiled with water, and filtered hot; and the colouring matter is precipitated from the filtered liquor as it cools. To completely separate this colouring matter, the patentee dissolves in the liquor either a tartrate, acetate, an alkaline or earthy chloride, an alkaline phosphate or pyrophosphate, or chloride of mercury, which precipitates the whole of the colouring matter. For dyeing, either the solution obtained by boiling the mixture in water, or the solid colour dissolved in water is used. The usual mordants, except the mineral acids, may be used with it. To obtain a solution sufficiently strong to print with, the mixture of aniline and bichloride of tin is treated while hot

[1] It ought to be known that some of the so-called Dandelion Coffee is a decided imposition, inasmuch as it is made of the root after it has been thoroughly exhausted in the preparation of the Liquor Taraxaci, and therefore is no better than [illegible] table fibre.—Ed.

with acetic acid, alcohol, or wood spirit, and the colouring matter is precipitated as before described. Another red dye is produced by mixing with aniline bichloride of mercury, perchloride of iron, or protochloride of copper, and treating this mixture as the former.

The inventor gives the name of Fuchsiacine to these colours, from their resemblance to that of the fuchsia.

Mineral Phosphates of Lime.—M. Mennons, of Paris, has patented improvements on the treatmeat of this substance. He dissolves the phosphate of lime out of Coprolites by means of hydrochloric acid, and then reprecipitates it with ammonia; and so, he says, he obtains a "thoroughly soluble and assimilable phosphate of lime for agricultural purposes."

Lubricating Cartridges.—Dr. Scoffern patents a composition for lubricating cartridges. He uses a mixture of equal weights of paraffine and naphthaline, preferring, however, a compound made by melting india-rubber in an open vessel over a fire, and thoroughly mixing with it four times its weight of paraffine, and one half its weight of naphthaline. The mixture when wanted for use is melted in an oil bath, and the temperature is kept as near 240° as possible. The advantage of the compound is said to lie in the fact that it is volatilised without change on the application of heat.

CORRESPONDENCE.

To the Editor of the Chemical News.

Sir,—On receiving your circular, it struck me that I would send you a few lines to let you know my ideas of the way in which you could best serve the interests of "the large body of pharmaceutical chemists." We have long wanted an impartial organ of free discussion, and also the earliest information obtainable respecting all matters connected with our business. But the business of a chemist and druggist must be looked at from two points of view, for it has a professional and a commercial aspect. We deal in knowledge as well as drugs. In a professional point of view we consider ourselves part and parcel of the medical profession; and we believe it impossible to separate the interests of the doctor and the druggist. We willingly accept our status as in some respects a lower one; but at the same time we believe that the intelligent dispensing of medicines is only of less importance than the intelligent prescribing of them. It is this position which we hope you will claim and advocate for us.

As tradesmen buying and selling we wish simply to be let alone. Like all other trades, we shall thrive by free competition. We ask no monopoly, not even of a name. We want no protection, not even in the sale of poisons, for practically, it would be impossible to afford it.

The great object of the Chemical News, however, should be to equalise, as far as possible, our advantages, — to bring the druggists who may happen to live at the Land's End or John o' Groat's as quickly as possible to a level, in point of information, with those who may live nearest to Bloomsbury Square. As a manufacturer of some things, I do not intend to communicate any secrets I may be possessed of, and I wish every other manufacturer to enjoy the fruits of *his own* ingenuity. If a neighbour knows or finds out a cheaper way of making any article than that I am acquainted with, by all means let him keep it to himself, and get all he can by it. But if you, as an independent journalist, become possessed of the secret, I expect you, in consideration of my three pence a week, to tell it at once; and you may do the same with any of mine when you find them out. And when a quack compound is called a new alkaloid, or a mixture of tartaric acid, carbonate of soda, and sulphate of magnesia is palmed off as citrate of magnesia, we expect you to denounce the imposition, and say that, apart from "abstract questions of morality," the thing is a cheat. Before all things, however, we expect from you a fearless exposure of everything in the shape of adulteration; for that is a sort of competition with which an honest man cannot fairly contend.

In conclusion, I would suggest a caution. You have had some predecessors who did not long survive—why, it is not hard to say. Let me advise you to avoid their faults, and then, if you honestly fulfil the programme you have issued, there can be no question of your permanent success.

I am, &c.

London, Dec. 5. M. P. S.

To the Editor of the Chemical News.

Sir,—Anticipating your appearance with much pleasure, I write at once to ask your aid and assistance in the Early Closing movement. When we have the help of such a man as Professor Wilson the time cannot be far off when we shall accomplish our object; you can help us by advocating a combination of masters to effect the desirable end. The *Pharmaceutical Journal*, of course, does not feel disposed to give us any assistance, so I appeal to you. All of us hoping one day to be masters ourselves, we consider it to be a change as desirable for them as for assistants. While we are shut up as we are, you can do us some good too by giving us good reports of the meetings, and by telling us all that is going forward in the Pharmaceutical world.

I am, &c.

An Assistant.

Chemical Notices from foreign sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

Dilatation of Gases. — M. Baudrimont[1] has lately addressed to the Academy of Sciences at Paris, a long paper on the dilatation of gases and vapours which he desires to be examined by a commission of members, and in which he thinks he has satisfactorily proved that, contrary to the opinion generally professed, the laws of Gay-Lussac and Mariotte are rigorously true for all elastic fluids, *i. e.* that all these fluids have the same coefficient of dilatation, and occupy volumes which are proportional to the pressure they support.

Aluminium. — M. Degousse[2] has succeeded in beating out aluminium into leaves as thin as those obtained with gold and silver. The operation is attended with a certain difficulty; it is frequently necessary to temper the metal; this cannot be done, however, in the ordinary manner as with silver and gold, a very slight heat only must be employed. The beating is done as usual. These thin leaves of aluminium can be substituted for silver-leaf; the colour is less brilliant than that of the latter metal, but, according to the author, aluminium-leaf is more durable, and may be employed with advantage for decorative purposes.

The metal can also be obtained in very fine powder by means of these leaves.

Aluminium in this state (beaten out into leaves) possesses a remarkable combustibility; it can be lighted with a taper like so much paper, and burns vividly with a brilliant white flame.

At the last meeting of the Academy of Sciences, at Paris, M. Dumas[3] called attention to a helmet in aluminium, manufactured by MM. De la Chaussée and Mourey. This casque is very solid and finely ornamented, gilded, &c. It only weighs 700 grammes, or about $1\frac{1}{3}$ lbs English.

Niobium.—H. Rose[4] has published many details on niobic acid. It is obtained on decomposing, by water, the yellow chloride of niobium. Niobic acid does not exist as such in the niobiferous minerals, for instance, in the Columbites

[1] *Comptes-Rendus, 1er Novembre*, 1859.
[2] *Répertoire de Chimie*, Nos. 13 and 14, 1859.
[3] *Cosmos*, vol. xv. p. 638.
[4] *Poggendorff's Annalen*, c. vii. p. 409.

(Baierne) from Bodennais and from America, Samarskite, Euxenite, Fergusonite and Tyrite. This acid is very analogous to tantalic acid, but has a less specific gravity, and can be reduced to an inferior degree of oxidation.

Niobic acid is white after calcination, but remains yellow while hot. Sulphuric acid precipitates it completely from alcaline niobates unless fluorine compounds are present. Hydrochloric acid does not precipitate it completely, and with sulphuric acid a slight heat and repose are requisite for complete precipitation.

When a solution of an alkaline tantalate is over saturated with hydrochloric acid, and a bar of zinc introduced, the solution sometimes takes a slight blue tint; with niobates this coloration takes place much easier, and the liquid becomes first bluish grey, then blue, and soon after brown. Finally the colour disappears altogether.

Many considerations tend to prove that niobic acid, like tantalic acid, contains 2 eq. of oxygen. Hyponiobic acid is an inferior degree of oxidation, obtained from the corresponding chloride (it was formerly thought to be the oxide of another metal, *pelopium*, which, however, does not exist.) Before the blowpipe, niobic acid gives, with phosphorous salt, a colourless glass in the oxidising flame, and a brown transparent glass in the reducing flame. Hyponiobic acid gives a blue lead in the same circumstances.

Action of Anhydrous Sulphuric Acid on Sulphurets.—M. Geuther[5] has shown that when anhydrous sulphuric acid is brought in contact with sulphuret of potassium, the mixture becomes heated and evolves sulphurous acid, at the same time bisulphate of potassa is formed. With sulphuret of lead, anhydrous sulphuric acid gives rise slowly to sulphate of lead, whilst sulphurous acid is evolved and sulphur deposited. Sulphuret of antimony in the same circumstances is converted into sulphate of antimony with evolution of sulphurous acid. Anhydrous sulphuric acid has no action upon protosulphuret of iron, upon pyrites, or upon sulphuret of copper.

Protochloride of Antimony.—M. Carpentier[6] employs a weak dissolution of protochloride of antimony as a varnish for galvanised sheet-iron. Galvanised iron being protected from oxidation by a layer of zinc, cannot be blackened and rendered brilliant by plumbago, as is the case with common sheet-iron. The author proposes the use of this galvanised sheet-iron for chimneys to stoves, fire-places, &c. When washed with a diluted solution of protochloride of antimony, the metallic surface becomes covered over completely with a brilliant black varnish which is very adhesive.

II. ORGANIC CHEMISTRY.

Quinic Ether.—M. Berthé[7] has published a paper upon quinic ether. This product has excited much attention lately in France. Quinic acid discovered by Hoffman, a pharmacien of Leer, and subsequently studied by Vauquelin, Pelletier, &c. appeared destined to remain interesting only in a purely scientific light. But certain experiments made with this substance—or at least with some unknown compound of it—by some Austrian medical men, show that intermittent fever can be promptly and radically cured by the inhalation of what they took to be quinic ether, administered like chloroform, at a dose of 2 or 3 grammes. According to M. Eissen, the substance in question is obtained by distilling a mixture of sulphuric acid, quinate of lime, and alcohol. The product is a colourless liquid with an agreable odour, rather less volatile than common ether. Inhaled like chloroform, at a dose of 2 or 3 grammes on a pocket handkerchief, it easily conquers an attack of intermittent fever, and prevents any return of the attack. The object of M. Berthé's paper is to show that the product obtained as above is not quinic ether, but a complex substance which it is impossible to obtain always the same.

MM. Hesse and Clemen[8] show that quinic acid is $C_{14}H_{12}O_{12}$, as was already known, and quinic ether $C_{14}H_{11}O_{11}, + C_4H_5O$. The latter far from being a volatile liquid, is a viscid substance, completely liquid only at + 50° (centigrade) having an aromatic odour and a strongly bitter taste. It has a yellowish colour, is soluble in water (which decomposes it), and in alcohol, difficultly soluble in ether. It distils with partial decomposition at 240° to 250° (centigrade) in a current of carbonic acid. Quinic ether is prepared by the reaction of one equivalent of iodide of ethyl upon one equivalent of quinate of silver. These substances must be chemically pure and cautiously weighed. The iodide of eythl is introduced into a long necked flask of strong Bohemian glass, with the quinate of silver. The neck of the flask is closed at the lamp, and the apparatus then placed in a water bath which is heated rapidly to boiling point for one hour. After cooling, the neck of the flask is broken, and the liquid portion remaining poured out. The quinic ether and iodide of silver formed remain sticking to the sides of the vessel. This syrupy mass is treated with alcohol, and the solution filtered by evaporation to syrup, the alcohol and non-decomposed iodide of ethyl are completely volatilised, and the quinic ether remains pure.

III. CHEMICAL ANALYSIS.

Calcination of Precipitates.—M. Græger[9] recommends the addition of a known weight of peroxide of iron to precipitates which are to be calcined in presence of organic matter or carbonaceous substances which are difficult to incinerate by ordinary means. He adds 10 or 20 per cent. of recently calcined peroxide of iron to the precipitate, and the application of a slight heat is sufficient to burn away all the organic or carbonaceous matter. The peroxide of iron, which is thus reduced to protoxide, takes back its oxygen again whilst cooling.

Detection of Plumbago in Iron reduced by Hydrogen.—M. Liénart[10] has found that the *pulvis ferri*, or iron reduced by hydrogen for medicinal purposes, is sometimes sophisticated with plumbago or black lead. This fraud is easily detected by dissolving the iron first with weak sulphuric acid, and terminating the operation with aqua regia; the plumbago remaining can be collected upon a filter and examined. The author has found as much as 14 per cent. in some specimens.

Artificial and Natural Camphor.—M. Dumont[11] has shown that artificial camphor can be easily distinguished from natural camphor by its reaction with ammonia. If the two products which resemble each other so closely be dissolved in alcohol, the alcoholic solution of natural camphor will not be precipitated permanently by ammonia, whilst the other solution produces with this reagent a flocculent precipitate which cannot be dissolved in the supernatant liquid.

SCIENTIFIC NOTES AND QUERIES.

Magnetic Peroxide of Iron.—As it is proposed to give a corner for any new facts that may be noticed in the course of working or experiment, I send the following in case you may think it of sufficient interest for insertion in the Chemical News.

Some time since I was making some experiments on the black magnetic oxide of iron, one of which was to notice any peculiarity that might occur in that oxide when ignited over a spirit lamp on platinum foil; after ignition the black oxide had apparently become converted into the common red peroxide of iron, but, on applying the magnet, to my great astonishment I found that its magnetic properties remained unimpaired.

The next question to determine was, whether it was still a combination of the two oxides having undergone some molecular

5 *Annalen der Chemie und Pharmacie*, t. cxi. p. 177.
6 *Répertoire de Chimie*, No. 12, 1859.
7 *Moniteur Scientifique*, 1er *Décembre*, 1859, p. 429.
8 *Idem*. p. 431.
9 *Annalen der Chemie und Pharmacie*, xciv. p. 149.
10 *L'Abeille Médicale*, No. 33, 1859.
11 *Journal de Pharmacologie de Bruxelles*, vol. xv. p. 442.

change or whether the protoxide had not become converted into peroxide by absorption of oxygen from the atmosphere; I therefore dissolved some of the red powder in hydrochloric acid, and to the solution added ferridcyanide of potassium, but not a trace of the proto-salt was indicated by that reagent.

The magnetic peroxide may also be conveniently prepared by fusing together for some minutes the common black oxide with 3 or 4 times its weight of nitrate of potash; prepared in this way it is more readily dissolved by hydrochloric acid than that obtained by simple ignition.

I have searched various chemical works but can find no mention of a magnetic peroxide of iron; I therefore presume that until now this peculiar compound has escaped observation.—*J. Robbins.*

Detection of Metallic Poisons in Medico-Legal Inquiries.—In Liebig and Kopp's Annual Report for 1850, English edition, p. 409, a process is given by Gaultier de Claubry for the detection of metallic poisons in organic mixtures by their electrolytic decomposition. The method is stated to be conveniently applied in judicial analyses. Has any instance been recorded of the employment of such a system? And what form will antimony and arsenic assume? will they escape as gaseous hydrogen compounds, or be deposited as reduced metal on the negative plate?—*Medicus.*

Soap Lyes.—Are the exhausted lyes of soap works treated for the glycerin they contain, or do they receive any other economic application?—*J. S.*

LABORATORY MEMORANDA.

Reinsch's Test for Arsenic.—In experimenting on different solutions of the salts of arsenic by Reinsch's test, it is very important to know that there is a considerable difference in point of time before the copper wire becomes coated with arsenic. The *Arsenites* show it almost the instant the liquid boils; whereas the *Arseniates*, or more highly oxidised salts, require a longer time and greater degree of concentration before any deposit is obtained. A knowledge of this fact may prevent an erroneous conclusion being drawn as to the presence of arsenic, although it may not be immediately detected.

In combination with chlorates, as proved by Dr. Taylor in Smethurst's case, no deposit is obtained, the arsenic remaining in solution; whilst the copper is dissolved, and imparts a blue colour to the liquid.

The *delicacy* of Reinsch's test has been greatly *underrated* by Taylor, Brande, and others, who state that arsenic fails to be detected when diluted to 120,000 times its bulk. How such a mistake should occur I cannot imagine; since, in accurate experiments lately made by me, I have detected it at a dilution of 560,000 times; and when at 280,000 times, the layer is so strong as to be fit for sublimation, having a bright steel colour: at 560,000 times, however, the deposit is more of a violet colour. These experiments were made by dissolving a grain of arsenious acid in a pint of distilled water, and diluting from time to time.

Compared with arsenic no deposit of antimony from a solution of tartar emetic took place at either of these points of dilution.—*J. Horsley, F.C.S.*

Arsenic in green Paper-hangings.—As this subject continues to excite a good deal of attention, we give a simple method by which the presence of arsenic may be immediately recognised, and if necessary, the quantity determined. Immerse a measured piece of the paper, say two square inches, in strong ammonia. If a blue colour be communicated to the ammonia, the presence of arsenic may be suspected. For a proof, remove the paper, and drop into the test glass a small crystal of nitrate of silver, which, if arsenic be present will quickly become covered with a yellow coating, which will disappear on stirring the liquid. If now it is wished to estimate the amount of arsenic, immerse the paper again in fresh ammonia until the liquid is no longer coloured blue, then evaporate all the solutions to dryness. Mix the residue with three times its weight of black flux, or carbonate of soda and sublime in a glass tube; then cut off the end of the tube, dissolve the sublimate in hydrochloric acid and precipitate with sulphuretted hydrogen; collect the precipitate on a weighed filter, wash well, dry, and weigh. Each grain of the precipitate corresponds to 0·8 of a grain of white arsenic.

MISCELLANEOUS.

Binoxide of Hydrogen.—Professor Schönbein has made the interesting discovery that during the slow oxidation of several metals (zinc, cadmium, tin, lead, bismuth, and copper) in moist air, appreciable quantities of binoxide of hydrogen are formed. The Professor, for example takes zinc filings, and makes an amalgam with mercury. This amalgam he stirs up in a tumbler with diluted sulphuric acid, by which means he reduces it to a rough powder and after well washing it he places the powder loosely in a funnel set over a bottle, and allows a thin stream of distilled water to trickle through. The presence of the binoxide in the water which has passed will be detected by the following tests which depend on the oxidising and reducing effects produced by the binoxide upon certain substances. Thin starch paste, containing some iodide of potassium, when mixed with the water, is in a very short time coloured dark blue on adding a few drops of a weak solution of any proto-salt of iron to the mixture. This test will succeed if the water contain only one-half millionth part of the binoxide. The red colour of a solution of permanganate of potash, slightly acidulated with sulphuric acid, is discharged by the dilute solution of HO_2. It will also precipitate Prussian blue from a mixture of the most dilute solutions of red cyanide of potassium and any *per* salt of iron. A dilute solution of chromic acid is a less delicate test, but it is coloured azure blue by water containing only $\frac{1}{50000}$th of the binoxide.

Water acidulated with sulphuric acid is found to give more of the binoxide than pure water, but the maximum quantity formed seems never to exceed $\frac{1}{3000}$th of the acidulated water.

Professor Schönbein supposes all slow oxidations in air to depend on what he calls the "chemical polarisation of neutral oxygen," which he is inclined to suspect is also deeply concerned in animal respiration, and many other chemical actions going on in nature.—*Abridged from a letter of Prof. Schönbein to Dr. Faraday, in the Philosophical Magazine.*

New Stopping for Decayed Teeth.—M. Feichtinger communicates the following recipe to the *Répertoire de Pharmacie*:—Take of powdered glass 1 part, oxide of zinc 3 parts, and mix them intimately. The two substances must be in impalpable powder, and the latter must be free from carbonate of zinc. Then take of a solution of chloride of zinc (density 1·5 to 1·6) 50 parts, borax 1 part. Dissolve the borax in a little hot water, and pour it into the chloride of zinc; borate of zinc is precipitated, which disappears on agitating the mixture. To make the stopping, mix the powder with enough of the solution to form a stiff paste. Only so much as may be wanted at the time should be mixed, as the compound quickly hardens. In the course of a day it becomes as hard as marble, and remains so, even after prolonged contact with water.

If the ingredients are pure, the stopping is perfectly white; but if it be required to match teeth of a yellowish colour, the necessary tint may be given by mixing a little ochre with the powder.

ANSWERS TO CORRESPONDENTS.

M. P. S.—We need hardly say that our opinions closely correspond with those of our correspondent, for whose communication we are obliged.

An Assistant.—The subject will receive early attention.

W. M.—1. The Chemical News can be obtained through any bookseller or news agent in town or country. 2. We know of no composition which satisfactorily answers the purpose. The matches must be dipped in varnish.

W. L. S.—We hope soon to satisfy our esteemed correspondent on all points.

G. M.—The subject to which you most particularly allude will receive our closet attention.

Dr. B.'s offer is declined with thanks.

R. D. Jun.—The suggestion shall be attended to.

D. Chem. Co.—We will give the suggestion careful consideration, and, if possible, comply with the request.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London, E.C.

THE CHEMICAL NEWS.

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WHY DO SHIPS ROT?

THE question is a very important one to a nation whose Government has paid more than half a million a year for the repairs of ships of war, not to speak of the enormous sums which must have been spent in maintaining its mercantile navy in good condition. Up to the present time chemists have busied themselves more in explaining the nature of the chemical changes which take place in the wood, and in devising means for preventing the disease, than in seeking for the efficient cause of the disorder. Our readers are familiar enough with the processes of KYAN, BURNETT, and others, all of which are to a certain extent successful in preserving wood; but in spite of all, the "timber plague" still continues its ravages, and a ship laid up in ordinary, when it is wanted for sea, is sometimes discovered to be in a condition which is quite extraordinary. What this "plague" is, chemists explain to us very clearly. They say it is a process of slow combustion, in which the elements of the wood under the influence of air and moisture become converted into carbonic acid and water; and they give the process the fine-sounding name of Eremacausis. But what brings about this change? No doubt there are many causes; but a paper which we publish to-day reveals one which is perhaps the most important of all. It seems that when we build our ships we, with much effort and great noise, drive into the timber agents which are more destructive than the dreaded Black Sea worms. Hitherto it has been done in perfect innocence; but for the future we shall know that, in the opinion of an eminent chemist, and an experienced dockyard officer, one cause of the rapid destruction of the hulls of ships is IRON NAILS!

How these act in promoting this destruction our readers will learn when they peruse M. KUHLMANN's paper, which has besides a practical bearing on other important matters. M. KUHLMANN believes that the energetic action of sesquioxide of iron is one cause of the spontaneous combustion which so frequently takes place in the waste of cotton and wool, and he thinks that the place where the iron (small fragments derived from the machinery) is deposited is the probable point of departure of the fire.

But M. KUHLMANN's paper also suggests that the destructive action of the sesquioxide may be employed for a very useful purpose. He found that the hydrated oxide agitated with water coloured by various organic matters energetically decolorised it; a fact which leads us to suppose that it might be a valuable agent in the purification of waters for the supply of towns. To this part of the subject we intend to return on an early occasion.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Oxides of Iron, considered as a means of conveying the Oxygen of the Air to combustible matters, by F. KUHLMANN.

[FIRST PART.]

IN the study of the phenomena which occur in the superficial strata of the globe, no source of action must be neglected; for however weak it may be, still, when assisted by the succession of ages, it may produce the most important modifications in the constitution of the globe.

The sources of action which it is especially important to probe to the bottom, are those in which the principal agent intervenes, not by its constituent principles, but only as a sort of carrier, to transport certain bodies and place them in conditions favourable to their combination with others.

When, in our manufactories, we make use of the binoxide of nitrogen to transport the oxygen of the air to sulphurous acid, and cause the latter to pass to a more advanced state of oxidation, or when we employ acetic acid intermediately to fix the oxygen and carbonic acid of the air upon lead, we make use of one of those levers which, in nature, give rise spontaneously to the most varied phenomena.

For many years I have paid attention to these successive and slow actions, and I have indicated their importance in various memoirs. Thus I have called the attention of chemists to the part played by oxygen in the phenomena of colour in plants, and in their decolorisation by sulphurous acid, and by putrefactive fermentation. I have investigated the properties of certain bodies capable of serving as reservoirs of oxygen to convey it to oxidisable bodies, adding some facts to the important observations of M. Schönbein. My researches upon the efflorescences of walls have led me to a thorough investigation of nitrification, in which slow and successive transformations play such an important part. This investigation, which includes the action of spongy platinum upon various gaseous mixtures, led me, as early as 1846, to show that there is an intimate relation between nitrification and the fertilisation of soils. I have since explained how ammonia, the immediate product of the decomposition of animal matters, passes, under the influence of aërated water and porous bodies, to the state of nitric acid or of nitrate of ammonia, and how in the lower parts of the soil the nitric acid formed, being deoxidised by putrefactive fermentation, is brought back to the state of ammonia. I have also shown how ammonia intervenes, without decomposition, in transporting nitric acid to lime and magnesia, when the carbonates of these bases form constituent parts of arable soils, just as carbonate of ammonia intervenes to displace the silica of the alkaline silicates, giving rise to siliceous petrifactions.

Lastly, with regard to industrial applications, I have

shown how a limited quantity of carbonate of potash or soda might serve to precipitate indefinitely carbonate of lime in a pulverulent state from the chalky water which is used in steam boilers, thus preventing those incrustations which are so injurious to boilers.

A particular circumstance has lately recalled my attention to these slow and successive phenomena, in which transporting agents intervene.

Alteration of the timbers of ships. — In passing through the dockyards at Dunkirk, I had the opportunity of examining the fragments of a ship in course of being broken up, and I was much interested in observing a great alteration of the planks at all points where the wood had been traversed by iron nails or bolts. At a distance of several centimetres from these points the wood was half carbonised by a sort of eremacausis; the portions thus burnt were detached by a slight effort, the fibre of the wood having lost all its elasticity. Nothing of the kind was produced where the wood had been fixed by means of copper or wooden bolts. I have learnt from M. Frénneville that this phenomenon is general; that it is averred to be the cause of the rapid destruction of the hulls of wooden ships, and that for this reason it deserved to be thoroughly investigated.

The explanation which first of all presented itself to my mind, consisted in assuming that the iron, under the continuous action of the sea water and air becomes rapidly oxidised, and that the oxide formed, when in contact with the wood, undergoes an opposite action, and passes under this deoxidising influence from the state of sesquioxide to that of protoxide. The protoxide again takes up oxygen from the air, and transports it again to the wood, causing this continuously to undergo the alterations to which I have referred.

In this way iron would fulfil, with regard to wood, and consequently to combustible matters in general, the part played by binoxide of nitrogen in the manufacture of sulphuric acid, by acetic acid in the manufacture of white lead, &c. The sesquioxide of iron would undergo modifications analogous to those to which nitric acid is subject in arable lands, where, under the influence of the putrefaction of organic matters, it passes to the state of ammonia, to regenerate itself again at the expense of the oxygen of the air or of oxidising bodies.

It is, moreover, easy to convince oneself that it is in the properties of the iron that we must seek for the cause of the alteration of the wood; for this alteration takes place at all points where the oxide is present; it extends parallel to the fibres of the wood, as far as the iron has been capable of transportation into its thickness by the action of some solvent.

If the alteration was confined to oak timber, we might inquire whether tannin may not have had some influence in the reaction; but the same phenomena are presented by deal. It is therefore in the oxide of iron alone, whatever may be the cause of its development, that we must seek for the key of the alterations observed.

I have also ascertained that the oxide of iron fixed in the wood is not at the same degree of oxidation throughout the mass. In the state of sesquioxide it is in greater proportion in the superficial layers of the wood than in the centre, where the presence of protoxide of iron may be easily detected by ferrocyanide of potassium.

The preceding explanation supposes that sesquioxide of iron may be partially reduced merely by contact with organic matters not yet arrived at their putrefactive decomposition; the following are the results of some confirmative experiments:—

I. Hydrated sesquioxide of iron agitated in the cold with variously coloured solutions, causes their decolorisation very energetically by the formation of *lakes*. These lakes most frequently contain iron at the minimum of oxidation, the partial reduction of the sesquioxide taking place by the oxidation of the colouring matter. The colours upon which the action of sesquioxide of iron is most energetic are those of logwood, Brazilwood, cochineal, turmeric, and mahogany. The deoxidation is almost null with indigo and litmus.

These results being capable of explanation by the great affinity for oxygen possessed by certain colouring matters in the state in which they occur in plants, I had recourse, in other experiments, to organic matters presenting a closer resemblance to wood in their composition and properties.

II. Solutions of cane-sugar, glucose, and gum were boiled in presence of hydrated sesquioxide of iron. The reduction was very energetic with glucose, less so with cane-sugar, and weak with gum. With glucose the reaction is perceptible even in the cold.

III. Lastly, I tried the action of oil of bitter almonds upon hydrated sesquioxide of iron dried at 212° F. The reaction took place in a sealed glass tube, which was kept at a temperature of 212° F. for ten hours. In this experiment a large quantity of protobenzoate of iron was produced. A portion of the oxide remaining undisturbed was in the state of protoxide.

We may add that the phenomena of destruction of organic matter in contact with oxide of iron, without the intervention of the deoxidising gases of putrefactive fermentation, are going on daily before our eyes. There is no one who does not know from experience that after one or two washings, spots of iron-mould in linen or cotton stuffs are replaced by holes; printing with iron presents the same defects, and too often stuffs dyed black acquire a brown tint; when, as they lose their strength, they are suspected of having been *burnt in dyeing*.

I shall add the following facts, observed during a long experience of bleaching by one of my pupils, M. Dietz:—

I. When the inner walls of the sheet iron washing troughs are laid bare by the removal of the calcareous incrustrations which usually cover them, and the iron comes into direct contact with the stuffs, the latter become covered with rust in the upper parts to which the air has free access, and in all the portions so spotted their alteration becomes inevitable.

II. When the common stuffs manufactured with the cotton waste contain scales of iron, produced from the cards or other parts of the machinery, this iron becomes rusted during the bleaching operations, and in four or five days the stuff is in holes, wherever the rust was deposited.[1]

It appears evident to me that this energetic action of sesquioxide of iron may be one of the causes of the spontaneous inflammations so frequent in the waste of cotton and wool. If the oxidation of the oils with which these materials are often impregnated be a circumstance in favour of these inflammations, the place where the

[1] M. E. Schwartz, who has paid attention to the causes of the alterations which I have indicated, asserts that, in dyeing, the protoxides of iron and manganese which are deposited upon the tissues and oxidized with the view of obtaining sesquioxide of iron and binoxide of manganese, often cause "the oxidation of the tissue itself upon which they are applied," and he establishes this proposition,—"*that a substance in becoming oxidised also causes the oxidation of the body in the presence of which it is, even when the latter is not oxidisable in an isolated state.*"—(Persoz, *Traité de l'Impression des Tissus*, I. p. 311.) I think that the considerations upon which I have entered will not bear any doubt in the minds of chemists as to the actual cause of the alteration of tissues. For the oxidation *par entraînement* assumed by M. Schwartz, I substitute a succession of reactions which has no limit except the destruction of the combustible material.

oxide of iron has been deposited is probably the point of departure of the fire.

The results of my experiments, and all these facts of daily observation, appear to be conclusive in making chemists to admit that sesquioxide of iron may serve to convey the oxygen of the air to organic matters, and thus hasten their destruction. This oxide acts to a certain extent as a reservoir of oxygen, filling itself at the expense of the air in proportion, as it empties itself for the profit of the combustion of combustible bodies.

As regards the alteration of the timbers of ships, now that the causes of this alteration are indicated, it will be sufficient no doubt for its avoidance that the iron nails and bolts should be tinned or coated with zinc, or replaced by nails and bolts of copper.

In the second part of this memoir, I shall take up the agronomic and geological questions attaching to it.—(*Comptes-Rendus*, 1859, *p.* 257.)

On Isomeric Alkaloids, by C. Greville Williams.

While investigating the organic alkaloids produced by destructive distillation, I was struck by the almost entire coincidence of the formulæ of the bodies found from the most opposite sources. Thus coal, bituminous shale, Dippel's oil (bone oil), and cinchonine, all appeared to yield alkaloids belonging to the same series. But although the composition of the same alkaloids from each source was identical, and even their boiling points agreed as well as could be expected, yet there were differences in the smell, power of forming crystalline salts, &c. which presented themselves during the course of these long investigations, and at times almost induced a belief that I was dealing with isomers instead of identical bodies. The greatest differences were found with the bases produced by destructive distillation of cinchonine. Here the odour of the alkaloids was so different to that of the same bodies extracted from other sources that I long oscillated between two opinions. However, the resemblances were too numerous to justify me in announcing the pyridine series, as obtained from cinchonine, to be a new class of alkaloids. In fact, the absence of absolutely distinct reactions rendered such a course impossible. I have, however, at length discovered a reaction with the chinoline series as obtained from cinchonine, which is so totally different from anything which can be obtained with the chinoline series from coal tar, that I am fully persuaded of their being essentially different.

Chinoline, or lepidine from cinchonine, was boiled with iodide of amyle for a few minutes, after which water was added, and the boiling continued for a short time. The product was a brown oily looking fluid suspended in the water. A little ammonia was now poured in, and the boiling continued for a short time longer, when the whole of the oil became converted into a magnificent blue colour of the utmost intensity. It dissolves readily in alcohol, and the diluted fluid dyes silk of a fast and most brilliant blue, having a slight shade of purple.

So strong is the attraction of silk for the dye that the bath becomes colourless, every trace of colour being taken up. It has but small tendency to unite with cotton, for if the latter, after being dyed blue, be boiled with silk, the cotton becomes colourless and the silk absorbs all the colour.

The coal tar bases of the same composition present nothing similar. They may, it is true, be made to yield superb colouring matters, but by totally different modes of procedure.

I am at present endeavouring to ascertain whether the pyridine series from cinchonine possess any features sufficiently distinct from the same series as extracted from coal, to justify the conclusion of their being a distinct class.

TECHNICAL CHEMISTRY.

The Analysis of Platinum Ores, by MM. Deville and H. Debray.

The ores of platinum contain the following substances:—

1. Sand. The whole of the sand is never removed by washing the ore; and the sand contains quartz, zirconium, chromate of iron, and, in the Russian ores, titanate of iron.

2. Osmide of iridium.

3. Platinum, iridium, rhodium, and palladium, combined no doubt in the form of an alloy.

4. Copper and iron which exist in the ores in a metallic state, for the iron found in the sand is not soluble in acids.

5. Gold, and, oftener than is supposed, a little silver. The latter metal is generally found with the palladium, and it is very rarely that palladium is obtained quite free from silver when it is prepared by the old processes.

1. **Sand.**—To estimate the sand we take a small assay crucible, or an ordinary crucible with smooth sides, and melt in it a little borax, so as to glaze the inside. We now introduce from 7 to 10 grammes of pure granulated silver, and 2 grammes of the ore, fairly taken and weighed very accurately. Over the platinum we put 10 grammes of fused borax, and one or two small pieces of wood charcoal. The silver is now melted, and care must be taken to keep it for some time a little hotter than the melting point, so that the borax may be very liquid, and may dissolve the vitreous matters which accompany the platinum and constitute the sand. The crucible is now allowed to cool, and when it is cold, the button, which will contain the silver, osmium, platinum, and all the other metals is detached, and if necessary digested for a time with weak fluoric acid to remove the least portions of borax. It is now heated to a faint redness, and then weighed. The weight of the button subtracted from the sum of the weights of the ore and silver employed, will give the amount of sand contained in the ore. For example:—

	Milligr.
Californian ore	2000
Silver	·7221
	9221
After fusion, the button weighed . . .	9162
Consequently the ore contained, sand . . .	59

It is very important to know this number, for it represents the only matter absolutely destitute of value which the ore contains; and this simple operation may be considered the most important performed in estimating the value of an ore. It is, besides, performed so quickly that it is as well to do at the same two or three specimens, taken from different parts of a lot of platinum powder.

2. **Osmide of Iridium.**—Another 2 grammes of the ore weighed very accurately are treated with aqua regia at 70° (Cent.) until the platinum is entirely dissolved. The aqua regia must be renewed occasionally for 12 or 15 hours, or until it is no longer coloured. It is best to perform this operation in a large beaker, and to place a cover over it to prevent loss. The solutions must be decanted with the greatest care from the metallic spangles of the osmide of iridium and the sand which remain at

the bottom of the beaker. If necessary it may be filtered, but as little as possible of the osmide must be allowed to go on the paper. The insoluble residue must be washed by decantation, then dried and weighed, after having added what remained on the filter. By subtracting the weight of this residue from the weight of the sand obtained in the former operation, we obtain the weight of the osmide of iridium. For instance, in the Californian ore we had :—

	Milligr.
Osmide of iridium and sand	81
Sand	59
Osmide of iridium	22

The button obtained in determining the sand, might be employed in this operation. In that case it is necessary to dissolve out the silver with nitric acid, and then proceed with the residue, as we have just directed.

3. **Platinum and Iridium.**—The solution in aqua regia obtained in the last operation is evaporated to dryness at a low temperature, and the residue is redissolved in a small quantity of water (if it should not entirely dissolve in the water some more aqua regia must be added, and the evaporation repeated), to which is added about twice as much pure alcohol; lastly, we add a great excess of sal ammoniac in crystals. The whole is now slightly warmed to complete the solution of the sal ammoniac, it is then stirred, and afterwards set aside for 24 hours. The orange-yellow, or even reddish-brown precipitate which is formed contains the platinum and the iridium, but some remains in the solution. The precipitate must be thrown on a filter and washed with alcohol. Afterwards the filter is dried in a platinum crucible, placed, for greater safety, within a larger one, and afterwards heated by degrees to low redness. The crucibles are now uncovered, and the filter is burnt at the lowest possible temperature. Once or twice after the incineration of the filter a piece of paper saturated with turpentine should be introduced into the crucible, by which means the oxide of iridium will be reduced, and the expulsion of the last traces of osmium will be effected. The crucible is now heated to whiteness until it no longer loses weight, or the reduction is finished in a current of hydrogen.

The liquid separated from the platinum-yellow by filtration, is evaporated until the chloride of ammonium crystallises in great quantity. It is allowed to cool, is then decanted, and on a filter is collected a small quantity of a deep violet coloured salt, which is the ammoniochloride of iridium mixed with a little of the platinum salt. This is first washed with a solution of sal ammoniac, and then with alcohol. The salt is then ignited, and if necessary reduced by hydrogen like the platinum salt. The mixture of platinum and iridium obtained by the two reductions is then weighed. The two metals are now digested at about 40° or 50° (Cent.) in aqua regia, diluted with about 4 or 5 times its weight of water—the aqua regia being renewed until it is no longer coloured. The residue is pure iridium. To obtain the weight of the platinum the weight of the iridium is subtracted from that of the mixture of the two. This method of separating the two metals is very accurate if the aqua regia used be weak, and the contact with it is prolonged.

4. **Palladium, Iron and Copper.**—The liquor charged with sal ammoniac and alcohol, from which the platinum and iridium have been separated, is evaporated to get rid of the alcohol, and then treated with an excess of nitric acid, which transforms the chloride of ammonium into nitrogen and hydrochloric acid. It is now evaporated almost to dryness. The residue is removed to a covered porcelain crucible which is weighed with great care. When the matter is dry it is moistened with concentrated hydrosulphuret of ammonia, and afterwards dusted over with 2 or 3 grammes of pure sulphur. When dry, this crucible is placed within a larger one of clay, and surrounded with pieces of wood charcoal. The two covered, are now set in a cold furnace which is filled up with charcoal, and the fire is lighted at the top to avoid the projection of any matter from the crucible, if it were too quickly heated. After reaching a bright red heat, the crucibles are allowed to cool. The porcelain crucible now contains palladium in a metallic state, with the sulphides of iron and copper, and also the gold and rhodium. This mixture is moistened with concentrated nitric acid which, after prolonged digestion at 70°, dissolves the palladium, iron, and copper, forming at the same time a little sulphuric acid. The solution of the nitrates is poured off the residue which is washed by decantation, and the solution and washings are evaporated to dryness, and then calcined at a strong red heat. In this way the palladium is reduced, and the iron and copper pass to the state of oxides, which are easily separated from the palladium by means of strong hydrochloric acid. The palladium remains in the crucible in which it is again strongly ignited and then weighed.

The chlorides of iron and copper are now evaporated to dryness at a temperature but little above 100° (Cent.), and are then treated with ammonia. The sesquichloride of iron having lost nearly all its acid, has become insoluble; but the chloride of copper is readily dissolved, and may be filtered from the iron which is washed, ignited, and weighed. The copper solution is now evaporated almost to dryness, and then mixed with excess of nitric acid, and heated to drive off the chloride of ammonium. Afterwards the nitrate of copper is ignited and weighed. The weight of the copper is always so small that the hygrometric water the oxide of copper may absorb may be neglected.

5. **Gold and Platinum?**—The residue insoluble in nitric acid is weighed and treated with very dilute aqua regia, which takes up the gold, and sometimes, but very rarely, traces of platinum. To ascertain if platinum be present, evaporate to dryness, and redissolve by alcohol and chloride of ammonium. If any platinum-yellow remain, it must be ignited and weighed. The difference in the weight of the porcelain crucible before and after the treatment by aqua regia, gives the weight of the gold, from which, if any be found, the weight of the platinum must be deducted.

6. **Rhodium.**—The residue left in the crucible is rhodium, which must be reduced in a current of hydrogen.

We append the results of some analyses of platinum ores, by MM. Deville and Debray.

ANALYSES OF PLATINUM ORES FROM VARIOUS SOURCES.

	Columbia.	California.	Oregon.	Spain.	Australia.	Russia.
Platinum	80·00	79·85	51·45	45·70	59·80	77·50
Iridium	1·55	4·20	0·40	0·95	2·20	1·45
Rhodium	2·50	0·65	0·65	2·65	1·50	2·80
Palladium	1·00	1·95	0·15	0·85	1·50	0·85
Gold	1·50	0·55	0·85	3·15	2·40	(1)
Copper	0·65	0·75	2·15	1·05	1·10	2·15
Iron	7·20	4·45	4·30	6·80	4·30	9·60
Osmide of iridium	1·40	4·95	37·30	2·85	25·00	2·35
Sand	4·35	2·60	3·00	35·95	1·20	1·00
Osmium and loss	. .	0·05	. .	0·25	0·80	2·30
	100·15	100·00	100·25	100·00	100·00	100·00

(1) Gold, if any, counted in the loss.

In conclusion, the authors caution experimenters who may follow in their steps to beware of the ill effects of osmium, which particularly attacks the eyes, and also to avoid breathing the vapour from the aqua regia. — *Annales de Chimie et de Physique.*

On the Production of the Purple and Rose-red Murexide Colours in Cotton Printing, by Dr. Von Kurrer.

Murexide may be used in stuff printing, either in a powdered or pasty state. It need neither be chemically pure nor crystallised, because in such conditions it is too high in price.

A. Printing with the Colour.— In 72 pounds of boiling water, 24 pounds of crystallised nitrate of lead are dissolved; and when the solution has cooled to 144° F. 5 pounds of dry, powdered, or 15 pounds of pasty murexide are dissolved in the fluid, and afterwards 36 pounds of finely powdered gum; after which the whole is passed through a handkerchief or a fine sieve, and left to cool, in which state it may be employed either for hand or roller printing.

After printing, the stuffs are hung up in a damp place until the impressed part feels soft, when the purpurate of lead is fixed upon the fibres by means of gaseous ammonia. This is best effected by hanging the stuffs in a hermetically closed chamber, such as is used for the sulphuring of woollen and silken tissues, by means of sulphurous acid. In place of the sulphurous acid produced by the combustion of sulphur, in this case gaseous ammonia is evolved from caustic lime and muriate of ammonia.

B. Passage of the Stuffs through the Sublimate Bath.—The pieces of stuff treated with gaseous ammonia are now passed through a bath containing in 1500 pounds of water, 2 pounds 11 ounces of corrosive sublimate (bichloride of mercury), previously dissolved in water.

In this bath each 3 pieces, of ¾ wide and 60 Brabant ells long, united together, are passed backwards and forwards; then for each following 3 pieces, 3 ounces of sublimate, dissolved in water, are added. It depends on the pattern whether a greater or less number of pieces can be passed through the heated bath.

Light patterns enable 30 pieces of stuff of the above dimensions to be treated in the same bath; whilst with heavy designs a fresh bath must be prepared after 20 pieces have been treated.

As soon as each three pieces have passed through the sublimate bath, they are hung in flowing water until the pieces are collected, when they are passed together through the acetate of soda bath in an ordinary dye trough.

C. Acetate of Soda Bath.—This consists of 3000 pounds of water, into which 1 pound of acetate of soda and 1 pound of muriate of ammonia have been stirred.

In this bath 10 pieces of stuff attached to one another are passed to and fro over the *harpel* for twenty minutes, then washed clean in running water, freed from water in the wringing apparatus, and dried cold.

In the same bath, furnished with 1 pound of acetate of soda, but with no muriate of ammonia, 10 pieces of stuff are again treated.

In this way prints of the most brilliant purple-red colour are produced. For pale gradations, in order to produce patterns in these different red shades, namely, dark-red, middling and pale rose-red, the normal colour for the two latter gradations receives a proportional addition of pure gum-water.

Cotton stuffs printed with murexide colours may be soaped without injury at 144° Fahr.; the colour also perfectly resists chlorine in the machine without any alteration; on the other hand, it is destroyed by hot aqueous vapours, and it is therefore impossible to combine murexide with the ordinary steam colours, such as green, blue, yellow, &c.

In cotton stuffs dyed with a single murexide red colour, the ground colour may be destroyed in particular spots, partly by oxidising and partly by deoxidising agents, and thus illuminated prints of the most beautiful and various patterns may be obtained. Thus by printing with acid zinc salts, orange figures are produced.

Dark grey figures are obtained by printing with protosalts of tin. Murexide printed upon medium pale-blue grounds produced with indigo, furnishes a remarkably fine violet. Stuffs dyed yellow with yellow vegetable pigments, receive figures of a Turkey-red colour when printed on with murexide.

Silken and woollen fabrics dyed of a uniform red with murexide, may be bitten with yellow by means of picric acid, when the latter is mixed with an acid capable of decolorising murexide. In the same way other active substances may be used for printing various figures of different colours.

D. Preparation of Murexide Plate-printing Red. For the plate printing of cotton fabrics, murexide will also be advantageously employed, when to 1 quart of the above-described purple colour are added 2 ounces of bichloride of mercury, and 2 ounces of acetate of soda, each dissolved in half a pint of water. The stuffs printed with this colour are hung up for three to four days, and then watered in the same way as in ordinary plate-printing. Murexide, however, can only be printed with wooden blocks, because brass decomposes the bichloride of mercury, and changes the colour; this is also the case in roller printing. — *Polytechn. Centralblatt*, 1859, p. 337.

Modern Applications of Chemistry.

Since there appears to exist in the community such very widely different opinions as to the extent to which chemical science is capable of being advantageously applied, it may perhaps be well in a periodical which is likely to be read by so large a section of the general public, to draw attention to the causes of this difference of opinion, and to point out that chemistry is neither on the one hand the magic wand which divines all secrets, nor on the other is it a mere system of theoretical ideas producing few immediate or practical results. It cannot fail to excite astonishment when we reflect on the rapid advance which natural philosophy has made in recent times, and how differently its study is appreciated now from what it was but a few years ago. Instead of being scarcely recognised as one of the branches of learning to be cultivated in our colleges and schools; an acquaintance with its principles is now considered as an essential part of a liberal education. Of all branches of natural philosophy, none has of late years been a more general favourite than chemistry, and none has exercised so important an influence upon the progress of the arts and manufactures; and it is doubtless to this capability of application to the wants and requirements of every-day life that chemistry is indebted for the position it holds at the present day. Notwithstanding, however, the general knowledge which

now exists of this science, there is still a great deal of misapprehension as to what it ought to be expected to perform. There are many who imagine that a thorough theoretical knowledge of the science is sufficient to entitle the possessor to be regarded as an authority on all questions, manufacturing or otherwise, in which the principles of the science are involved. They assume that because they are acquainted with all the chemical changes which take place in any manufacturing process, that they are capable of undertaking any such operations, and of conducting them with greater skill and efficiency than men long practised in their particular callings, who have not the advantage of the same amount of theoretical information. On the other hand there are many engaged in various branches of manufacture, who, although unacquainted with the theory of the processes they adopt, have nevertheless by long experience, and by close and attentive observation of facts, made themselves so thoroughly masters of their business as to render it difficult for any less practised hand, however high his scientific attainments, to show in what manner his processes could be curtailed or improved. Such men are too apt to conclude that the ability to draw a correct and logical theory is but of minor importance, and are slow in perceiving the vast amount of time and labour which such theoretical knowledge, combined with their own experience, would save them in deciding on the value of the numberless proposed improvements which are every day forced upon their notice, and upon a correct judgment on which their commercial position may depend.

There can be no question that a thorough acquaintance with theoretical principles is the only basis upon which a sound knowledge of the science can be attained, but it should not be forgotten that however profound such theoretical knowledge may be, long practical experience is necessary before a thorough acquaintance with any of the varied manufacturing operations, to the successful prosecution of which chemistry is now so essential, can be acquired. If we recall to mind how the application of chemistry to any branch of industry has gradually developed itself, we cannot fail to perceive how the exaggerated estimate formed by some of its value has induced others to ignore altogether the advantages it is capable of conferring.

We are indebted to the publication of Liebig's letters on agriculture and the chemistry of food for the attention of the people of this country being first attracted towards chemical science. A new light appeared to have dawned upon the world which seemed to promise to make the most obscure processes clear as noon-day. Surprised and delighted at the simplicity of what had hitherto been so little understood, over-sanguine minds jumped at conclusions which proved to be fallacious, and decried as useless all practices that could not be logically explained. Nothing could apparently be more perfect and unquestionable than Liebig's theory of agriculture. Assuming that plants can obtain sufficient nitrogen from the air, the conclusion seemed obvious, that so long as the soil is supplied with the inorganic constituents of the plants grown upon it its fertility must remain unimpaired. Further experience, however, proves that the system pursued by practical agriculturists is correct, and that plants require more nitrogen than they obtain from the air and than they retain in their composition. Whether this nitrogen acts (as has been suggested) as a carrier of silica, or what other purpose it serves, is still unknown, but the fact is not the less established that nitrogen must be supplied in large quanties if a continuation of good crops is to be maintained. The first analyses of guano were very minute, very useful in a scientific point of view, but almost worthless for practical purposes, inasmuch as they afforded no data from which its value could be ascertained. It was not until the beneficial properties of artificial manures were found to depend principally upon the proportion of nitrogen and phosphates they contained that analysis of them could be considered to bear any relation to their money value. We now find them sold by analysis as regularly as soda ash by its degree of strength, without the correctness of such a mode of valuation being called in question.

Again, the idea that chemistry could be of service to the ironmaster or iron manufacturer has been looked upon as chimerical. It is true that the first results of chemical investigation in this direction only went to prove to how great a degree of perfection the processes of smelting and working iron ores had been brought, how well adjusted were the proportions of fuel and fluxes, and how judiciously the impurities of one ore were counteracted by admixture with others of a different character. Had the theory of these processes been as well understood as they now are, these results, arrived at by long practice, would have been more easily and speedily attained, in proof of which we have only to observe the rapid advances which have been made in the manufacture of iron within the last few years. We sometimes hear it argued that the chemical constitution of cast iron is no test of its quality. To some extent this may be admitted, inasmuch as an iron free from any objectionable matter may nevertheless, from mechanical causes, not possess the requisite strength and toughness; but it is no less true that an iron containing impurities beyond certain well ascertained limits can never be strong or tough, no matter to what process it may be subjected, so long as these impurities remain.

The effect of phosporous, silicon, and sulphur, upon the physical properties of iron are now well understood, and it is just as impossible for cast iron containing 5 per cent. of silicon to be otherwise than weak and brittle as it is for lead containing 1 per cent. of arsenic to be soft. It is true that to the practised eye of the ironmaker the quality of cast iron is rendered evident by the character of its fracture, and that chemical analysis is not always necessary in order to ascertain its value; but analysis is not the less of service in showing the cause of inferiority, if such exists, and in pointing out the best method of correcting it. When we call to mind the mistaken views which scientific men have too often upheld from not basing their theories upon experiments conducted on a sufficient scale, we can scarcely be surprised at finding the experienced manufacturer very cautious in adopting opinions which do not appear to be borne out by practice; preferring to continue a process, the reason of which he may be unable to explain, until it is indisputably proved that the desired result can be attained without it. If chemists would bear in mind that laboratory experiments are not always attended with the same results when carried out on a larger scale, they would less frequently have to retreat from positions the too eager defence of which has not been without detriment to their credit and prestige. With every year chemistry widens its sphere of action, affording full scope for those who labour in the fields of purely scientific research as well as for those whose minds have been cast in a more practical mould, and we cannot doubt that the more generally an aquaintance with the principles of the science is cultivated, the more highly will the services it renders to society be increased and appreciated.

PHILO-TECHNOLOGY.

PHARMACY, TOXICOLOGY, &c.

CHINOVINE.

The matter extracted from the cinchona barks, and known variously as chinovic acid, red cinchonic, cinchonic bitter, has been made the subject of a long investigation by H. Hlasiwetz and Dr. von Gilm. They have decided that it is a glucoside having the composition $C_{60}H_{46}O_{16}$. In an alcoholic solution, under the influence of chlorine, this breaks up into a sugar which the authors consider identical with the mannitane of Berthelot, and an acid which they call chinovic acid, a change explained thus:—

$$\underbrace{C_{60}\,H_{48}\,O_{16}}_{\text{Chinovine.}} + 2\,HO = \underbrace{C_{48}\,H_{28}\,O_8}_{\text{Chinovic acid.}} + \underbrace{C_{12}\,H_{12}\,O_{10}}_{\text{Mannitane.}}$$

The acid falls as a crystalline powder. These crystals are washed with weak alcohol, and then dissolved in strong boiling alcohol, from which they crystallise. The crystals appear to be regular six-sided prisms. They are insoluble in water, only slightly so in ether, but more soluble in boiling alcohol. They dissolve freely in ammonia and the fixed alkalis. All the solutions are bitter. The mineral acids displace the chinovic acid from its combinations, the acid separating as a gelatinous mass. It is feebly monobasic, and decomposes the alkaline carbonates. The salts of potash and soda are uncrystallisable. Those of baryta, strontia, and lime, prepared by double decomposition, fall as gelatinous precipitates soluble in an excess of water. The chinovate of silver falls as a voluminous precipitate which is very sensible to light. Nitric and sulphuric acids have no action on chinovic acid.—*Chem. Central Blatt*, No. 52.

THE EXTRACTION OF POTATO STARCH.

In the manufacture of this article a considerable quantity of the product is lost owing to the strong affinity the starch has for the fibre of the potato. From M. Anthon's experiments on the subject, it appears that the manufacturer only extracts two thirds, and that the remaining third is left in the pulp. M. Anthon suggests that this third may be utilized by converting it into sugar, by means either of malt or dilute sulphuric acid. By employing 10 per cent. of the acid to the dry fibre, the saccharification is completed in about two hours and a half; but if only 3 or 4 per cent. of acid is used, the boiling must be continued for at least five hours. Ten per cent. of malt effected the conversion in six hours. The result as to the quality and quantity of sugar produced is the same whether it is obtained by malt or sulphuric acid. — *Chemisch Central Blatt*, 1859, 33—513.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, *November* 3, 1859.

(THE FIRST MEETING DURING THE PRESENT SESSION.[1])

Professor B. C. Brodie, *F.R.S., in the Chair.*

A Paper was read by Dr. Edward Smith, Assistant-Physician to the Brompton Hospital for Consumption, detailing the results of experiments in continuation of those already communicated by him to the Royal Society (January 20th, and February 10th, 1859), and by which he has been led to several interesting facts explanatory of the phenomena of respiration. The inquiry commenced with the determination of the average amount of carbonic acid and aqueous vapour expired from the lungs after an interval of several hours' fasting; and in the second place comprehended the influence exerted by various kinds of food in disturbing this normal amount, under conditions both of rest and muscular activity. The apparatus employed by Dr. Smith to measure the air inspired consisted of a small dry gas-meter or spirometer, through which a full supply was conducted to the individual, whose mouth and nostrils were covered with a small mask; the products of respiration were passed first into a desiccator containing sulphuric acid to absorb water, and thence into a gutta percha box, divided into numerous compartments, and charged with caustic potash, by which the carbonic acid was retained. The author concludes that his experiments have established the existence of a class of foods to which the term "excito-respiratory" may be applied, and which comprehend nearly all nitrogenous articles of diet, also sugar, coffee, and especially tea, the latter causing a greater evolution of carbon than it supplied. The most remarkable among the "non-excitants" were starch and fatty substances. The administration of alcohol produced results differing according to the nature of the sample: rum and spirits of wine always increased the evolution of carbonic acid, while brandy tended on the contrary to diminish the activity of the respiratory process.

A short discussion followed the reading of this Paper, in which Drs. Gilbert, Harley, and Marcet, and Mr. Alfred Smee took part.

Professor C. L. Bloxam then read a short account of *The Hydrates of Baryta and Strontia*, in which, after referring to the uncertainty regarding the composition of the crystallised hydrates, he stated the results of his experiments to have led him to the formulæ $BaO + 9\,HO$, and $SrO + 9HO$ respectively. The baryta compound was obtained by boiling together the nitrate of baryta and caustic soda, when it separated on cooling, and was easily purified by two or three crystallisations. The crystals so produced effloresced in air of the ordinary condition of dryness, and lost seven equivalents of water in vacuo over sulphuric acid or on exposure to the temperature of the water oven. The hydrate of strontia imitated the deportment of the baryta compound, excepting in the result of heating to redness, when, contrary to usual statements, it loses all its water, becoming converted, as would lime, into the anhydrous condition.

In connection with the subject of Mr. Bloxam's paper, the President exhibited a specimen of precipitated anhydrous peroxide of barium, as obtained by adding baryta water to the solution of the crude peroxide in cold hydrochloric acid, which he considered well worthy of more extended investigation.

Thursday Evening, November 17.

Dr. W. A. Miller, *in the Chair.*

A description of an hermetically sealed barometer was communicated by Mr. Adie of Liverpool. The instrument, constructed of glass, is described as being very sensitive to slight differences of atmospheric pressure; it is compensated for temperature, but on account of its indications being disdisturbed by the effects of partial heating, the method of suspension by a cord when in use was recommended. It is to be regretted that no model or drawing of the instrument accompanied the written description.

A note relative to the more perfect purification of the lead compounds obtained in the preparation of the fluorescent substances, paviin and æsculin, from horse-chestnut bark, was communicated by Professor G. G. Stokes.

The theoretical views advanced by Dr. Kolbe in reference to the relation existing between lactic and propionic acids,

[1] In order that the readers of the Chemical News may be placed in possession of a complete record of the meetings of this Society during the present session, we now give an abstract of the two meetings which took place previous to the publication of our first number.—Ed.

became then the subject of discussion, in which Dr. A. W. Hofmann and Dr. Odling took part; after which the meeting was adjourned.

NOTICES OF BOOKS, PATENTS, &c.

A Manual of Qualitative Chemical Analysis, by A. Beauchamp Northcote, F.C.S., Demonstrator to the Professor of Chemistry at Oxford; late Senior Assistant in the Royal College of Chemistry, London; and Arthur H. Church, F.C.S., of Lincoln College, Oxford; late Assistant to Professor Brodie. London: Van Voorst.

Chemists still talk of organic and inorganic chemistry as if the two branches were two trees of different families. So little do some appreciate the unity of the science, that, forgetting, or not even knowing how truly (like a hypothetical republic) it is one and indivisible, they speak of "organic chemists," and we once heard a distinguished cultivator of the science spoken of as "*only* an organic chemist." It is on this principle of division that by "qualitative chemical analysis" is always understood the qualitative analysis of inorganic bodies. Treatises on the subject, it is true, usually contain tables for the detection of a few of the more important organic acids, but the qualitative analysis of organic bodies generally has not as yet been reduced to rules. The reason of this is that chemists of the Bracconot school exist no longer. The proximate analysis of mixtures of animal and vegetable substances is still a problem bristling with difficulties. If difficulties exist then there is honour to be gained in overcoming them. Let us hope that chemists will soon begin to search for a little honour in this direction.

The time has been when qualitative analysis was a charming study. But the days when a skilful analyst could scarcely take up the investigation of a few minerals without being rewarded by the discovery of a new substance or new combination of substances has passed away, never perhaps to return. The pleasures derived from chemistry are principally due to the gratification of curiosity. Those alone who really love it, know the feeling with which a working chemist applies himself to the solution of a problem. As soon as the matter can be reduced to rule nine tenths of the charm has fled. This then is the reason why the compounds of carbon are now more investigated than the products of the so-called inorganic world. Let any one read Klaproth's Analytical Essays, throwing himself back as it were into the time, let him read the description of his attempts to dissolve the precious stones, his delight at the advent of the "flint grinding dish," his proof of a specific difference between baryta and strontia, founded on the difference in their atomic weight[1], let him, we say, read this, and he will see how delightful a pursuit inorganic analysis has been. It is almost impossible now to place oneself in a similar position towards any save organic bodies. Here problems present themselves at every step for solution, here there are seldom rules of such universal applicability as to prevent the necessity for the use of judgment and ingenuity.

The treatise before us is one of the books the very value of which depends on the perfect manner in which it brings analysis (at least so far as can be done without reference to quantities) within the scope of any one possessing an average amount of patience and intelligence. Written by men who are not only perfectly and practically familiar with the subject, but who have for years been engaged both in teaching and making investigations, it possesses an amount of authority which we cannot accord to the productions of those who, for aught that the chemical world know to the contrary, never made an investigation or even an analysis.

The unitary system having been adopted in some of the principal laboratories, it became desirable in order to avoid confusing students to give them text-books having the symbols and equations in the new notation. The present work has been written not only with this view, but also to enable advanced students to make qualitative analyses of the rare substances so often omitted in elementary treatises.

One feature in the work before us is especially deserving of notice, namely, the perfect order, method, and sequence of the reactions. For example, in describing the properties of substances, the salts are not put down at random, but in the order of basity, thus mono-, bi-, and then tribasic salts. In like manner the reagents employed are always in the same order, the characteristic reactions being printed in bolder type, so as at once to arrest the attention.

The directions to students as to the proper method of pursuing their analyses, and the precautions necessary to ensure success, are all excellent. We understand that Professor Brodie has made this manual his laboratory text-book. We are sure that he will find the correctness of his judgment confirmed by the rapidity and ease with which his students will advance.

On the Comparative Value of certain Salts for rendering Fabrics non-inflammable: being the substance of a Paper read before the British Association at Aberdeen, by F. Versman, F.C.S. and Alphons Oppenheim, Ph. D., A.C.S.

Women have a right to complain that while men have expended an immense amount of ingenuity in protecting themselves from one element—witness the enormous number of patents for rendering fabrics mostly employed for male garments *waterproof*—they have done very little to protect women from the more dangerous and domestic element—fire. We are happy to see that something has been done to wipe away the reproach; and it ought to be known that it has been done at the command of her Majesty, at whose request the Master of the Mint employed the authors of the above paper to make experiments, the use of the royal laundry being granted for the purpose. Here, and at other places, the authors tried every salt they could think of, and some salts which few persons would ever have dreamt of employing. Of the substances used, however, two only seemed to fulfil all the purposes required. These are sulphate of ammonia and tungstate of soda; but as both of these salts are soluble, the difficulty of *fixing* an anti-inflammable substance in a fabric has yet to be overcome. For laundry purposes only the tungstate of soda can be recommended, inasmuch as the sulphate of ammonia sometimes produces brown spots like iron-moulds, when the fabric is ironed. The tungstate, however, offers one difficulty, viz. the formation of a bitungstate of little solubility, which crystallises from the solution. To obtain a constant solution, a small percentage of phosphate of soda must be added. "The best way of preparing a solution of minimum strength is as follows:—A concentrated solution of tungstate of soda is diluted with water to 28° Twaddle, and then mixed with 3 per cent. of phosphate of soda. This solution was found to keep and answer well, and has been introduced into her Majesty's laundry." We think her Majesty would be pleased if the authors were to inform her subjects exactly how this solution is used in her laundry; and we shall be happy to be the medium of the communication. Appended to the paper are tables, showing the smallest percentage of salts required in solution for rendering muslin non-inflammable, from which we learn that of crystallised tungstate of soda, 20 per cent., and of anhydrous, 16 per cent. are required; and of crystallised sulphate of ammonia 7 per cent. of anhydrous 6·2 per cent. are wanted.

An Improved process of Manufacturing Sulphate of Lead, Carbonate of Lead, Nitrate of Potash, and Sulphate of Soda. W. E. Newton: a communication.

The inventor first granulates his lead finely by melting and pouring through a perforated vessel into water. He then

[1] Klaproth showed that they evolved different quantities of carbonic acid when treated with acids.

places it in a suitable vessel which he charges with nitric acid. After standing for some time the acid is drawn off into a second vessel with a quantity of similarly prepared lead, and this is repeated a third time. The nitrate of lead, now supposed to be neutral, is then treated with sulphuric acid, which precipitates the insoluble sulphate of lead, and the nitric acid is drawn off to be used in another operation.

The above process may be modified in the following manner:—A saturated solution of nitrate of soda is decomposed by sulphuric acid. The nitric acid of the nitrate of soda is thus set free, and sulphate of soda is formed. The whole is then heated in vessels of stone ware, or enamelled iron, and metallic lead is introduced, which is rapidly dissolved by the nitric acid. The nitrate of lead thus formed is immediately decomposed by the sulphate of soda, an insoluble sulphate of lead, and nitrate of soda being the result. The sulphuric acid is replenished from time to time, until all the lead is dissolved, when the liquid nitrate of soda is drawn off to be used with fresh quantities of lead and sulphuric acid as before.

The sulphate of lead is next decomposed by carbonate of potash and nitrate of soda, whereby are obtained carbonate of lead, nitrate of potash, and sulphate of soda. For this purpose 25 pounds of sulphate of lead are added to a saturated solution of 10 pounds of pearlash in water, which are changed by double decomposition into carbonate of lead and sulphate of potash. The solution of the latter is separated from the insoluble carbonate of lead, and is then decomposed by the addition of nitrate of soda, 12½ pounds being added for the above quantities of sulphate of lead and pearlash. The result is the production of saltpetre and Glauber salt, which are separated by crystallisation.

This process may also be varied as follows: "The nitrate of soda may be first decomposed by the pearlash by boiling them together, the result being nitrate of potash and carbonate of soda, the former to be separated by crystallisation. The carbonate of soda is then employed to decompose the sulphate of lead, and the result as before is carbonate of lead, nitrate of potash, and sulphate of soda; or the nitrate of soda, the sulphate of lead, and the pearlash, may be mixed together, whereupon a triple decomposition will take place. The carbonic acid of the pearlash uniting with the lead, the nitric acid of the soda with the potash, and the sulphuric acid of the sulphate of lead combining with the soda, and forming, as before, carbonate of lead, nitrate of potash, and sulphate of soda."

The above processes it must be confessed are very ingenious.

An improved means of giving increased strength to Paper.
THOMAS TAYLOR.

THE invention consists in soaking paper (either sized, unsized, or partially sized) in a concentrated solution of neutral chloride of zinc, either warmed, or at the ordinary temperature of the air. The solution must have the specific gravity of 2100, or thereabouts, when it will have the consistence of syrup. The paper to be treated must be immersed in, or floated on, the solution until it is fully saturated; it is then removed and washed with water. If it is desirable to retain a portion of the zinc in the paper, it is, after being partially washed, immersed in a weak solution of carbonated alkali, and then thoroughly washed in water. After this treatment it will be found that the paper is more or less changed, has contracted in volume, become more dense, less porous and much stronger. When it is desired to produce a more complete change, the solution must be heated, and the temperature may be varied from 80° or 90° F. to 212°, according to the effect desired. The change is completed when the paper becomes swollen, and apparently dry, as well as opaque and flaccid. If sheets of paper saturated with the solution be pressed together and ironed, they will become permanently united. In some cases the patentee dissolves cotton fibre, starch, dextrine or gum in the solution of chloride of zinc, or he adds the chlorides of tin, calcium, or magnesium; but the paper is always submitted to a thorough washing with water.

Paper thus treated, assumes more or less the toughness, semi-transparency, and general appearance of parchment.

Our readers will remember that Mr. Gaine produced the same effect on paper by immersing it for a few seconds in oil of vitriol diluted with half its volume of water. The change in both cases is no doubt essentially molecular. We should like to know whether the whole of the chloride of zinc is removed in the washing.

CORRESPONDENCE.

Modern Theories of Chemical Notation.

To the Editor of the CHEMICAL NEWS.

SIR,—There was a period in the infant days of chemical science, when facts were few and theories but crude, and when those who acknowledged the name of chemist were masters of the science in all its bearings. Times, however, have changed, and chemistry is now divided into numerous distinct branches, each offering a wider field for investigation than did the parent science itself in its earlier stages.

We thus have chemists organic and inorganic; chemists who devote their attention to analysis, scientific and commercial; chemists who are engaged in unravelling the mysteries of photography and kindred sciences. Again, we have the manufacturing branches, in which we find chemists labouring to improve the arts of dyeing, brewing, and the preparation of artificial manures; chemists who are busy in the production of lead- and zinc-whites, mineral and other pigments; in converting the ammoniacal liquors of gas-water into sulphate of ammonia for the manufacture of alum and for sale to the agriculturist. Indeed, refuse of all kinds is sought to be turned to account by men who depend on chemistry for converting things of little or no value into marketable articles.

Each and all of these are guided in their labours by the facts and laws left ready to their hands by the scientific workers who have gone before. It is therefore necessary, when utilitarian views are thus uppermost in the minds of the many, and to a great extent justly so, that an occasional glance should be turned to the first principles of the science, in order to see that these keep pace with the facts constantly brought to light by more practical men.

With regard to organic chemistry, we are sufficiently active in this direction; scarcely a journal appears, but we see numerous facts given to the world, which are immediately ticketed and set apart by those who devote themselves to their classification, arranging them, of course, according to their particular views of the subject.

The frequent recurrence of difficulties in such a classification, has given rise to numerous modifications in the old views of chemical science, and we are not at present agreed amongst ourselves, as to which of these should be preferred, for although we may allow one class of bodies to look particularly well, when dressed according to a certain fashion, yet we find them as particularly ill-looking and out of place when an arrangement is adopted which shows to advantage another class of substances. Yet notwithstanding this unsatisfactory state of theory as regards organic chemistry, we cannot too highly appreciate the untiring labour of those who devote time, energy, and attention, to the study of the groupings of the thousand and one acids, bases, alcohols, and aldehydes at present known through that branch of the science. The other division of chemistry, which takes cognisance of the inorganic world, has likewise its votaries, although less numerous than those of the newer and apparently more fascinating kingdom governed by the elements C H O and N. In the old study of the relation of acids

to metallic oxides, and the reaction of salts upon each other, new facts are yet brought to light which are of sufficient interest to engage the attention of the few who still labour amongst the laws governing the mineral kingdom, and we have, therefore, some theorists who are just as busy keeping watch and ward over these facts on their appearance, as is the case in the other department.

And now, sir, what is the relation existing between these two branches of the same science, do they acknowledge the same fundamental principles? Are the elements which we assume as forming the basis of both, governed by the same laws under the different circumstances in which we find them placed by the different experimenters? To this we must unhesitatingly reply in the affirmative, and yet we see them under such apparently irreconcileable phases as almost to induce a doubt as to the reality of the fact.

The explanation of this must be sought for in the different manner in which organic and inorganic chemists regard the reactions of the elements and chemical changes in general. The existence of this discrepancy in the opinions formed by two persons viewing general phenomena in different lights, becomes more evident when we engage their attention on one in which we can place the theories side by side. Take for example water:—On one side we are told that water is the protoxide of hydrogen, and that its formula is HO; on the other hand we hear that it is more truly represented by $\frac{H}{H}O$, or two particles of hydrogen to one of oxygen; another time we find that the simplest portion recognised is a combination of atoms tabulated thus, $H_2^2O_2$

This is one of the examples of viewing the same substance with the eyes of the inorganic and organic chemist. No doubt each has good reason for giving the preference to one or other of these formulæ, but that such diversity of opinion should exist seems to indicate a strange want of understanding respecting the basis of chemical combination.

Neither can we compromise matters and say that all these forms are correct, that it is only as a matter of convenience that we represent water under these different phases, just as we are in the habit of writing at one time AmCl, at another NH_4^2Cl, or KCy and KC_2N. These cases are quite different, for $Am = NH_4$, and $Cy = C_2N$; but H is not equal to H_2, neither can 2 $\left(\frac{H}{H}O\right)$ be strictly formulated by $H_2^2O_2$: equal this latter might be, but by the peculiarity of its arrangement it is meant to represent something fundamentally different, and which could not be recognised by the grouping 2 $\left(\frac{H}{H}O\right)$.

We have then this question: "What is the proper way of expressing in chemical language that simplest of all compounds, water?" In the answer to this lies the clue to the solution of the difference we now observe in the notation of the two systems of Chemistry, and I think you will be ready to admit the incalculable benefit which would accrue from a full ventilation of the question at issue between the partisans of of the different theories.

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To the Editor of the Chemical News.

Sir,—A report has become almost universally diffused tending to the disgrace of the Chemical Society. As I can scarcely believe it to be true, I think it right to give the Society the opportunity of directly, or through one of its members, contradicting it.

It is said, that the distinguished chemist, M. Sainte Claire Deville, having been proposed as an honorary member, was blackballed from a personal feeling against the proposer, himself one of the most brilliantly successful chemists in Europe.

Now, Sir, as the Chemical Society have, ever since they existed, shown their unwillingness to hurt any candidate's feelings by blackballing him, even when such candidate was utterly unknown to science (as may be seen by looking through a list of the Fellows), I cannot think they would commence with such a man as M. Sainte Claire Deville.

Trusting you will give insertion to the above in the hopes of some light being thrown upon the affair,

I am, &c.

Aluminium.

Chemical Notices from foreign sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

Specific Gravity of Vapours at very High Temperatures.—The determination of the density or specific gravity of vapours produced by bodies whose point of ebullition surpasses the temperature at which glass becomes soft, appeared an almost impossible problem in the actual state of chemistry. The highest temperatures in the experiments of Dumas and of Mitscherlich for the determination of densities, never ranged above 500° (Centigrade). MM. H. Sainte Claire Deville and L. Troost[1] have, however, succeeded in taking the densities of several vapours at very high temperatures, by conquering the three difficulties which arrested former experimentalists, viz. the nature of the vessel employed, the constancy of the temperature employed, and thirdly, the estimation of this temperature.

The vessel is of porcelain; it has a long neck which can be closed when required by the flame of an oxy-hydrogen blowpipe. The constant temperature at which the density is determined is produced by the vapour of a body whose point of ebullition is much higher than that of the substance experimented on.

The vapours destined to furnish this constant temperature are produced in a distillation apparatus of iron, which the authors have already described (*Comptes-Rendus*, xlv. p. 821). The substances employed to effect this are mercury for a temperature of 350°, sulphur for a temperature of 440°, cadmium for 860°, and zinc for 1040° (Centigrade).

As to the temperature, the authors have avoided the difficulties which attend its exact determination by operating comparatively, and in precisely the same conditions, with the substance whose density it is required to know, and another substance the density of whose vapour is known with certainty. MM. Deville and Troost have preferred to compare their operations with the vapour of iodine, as the great weight of this vapour renders the errors of weighing much smaller. Their experiments give them, directly, the relation existing between the density of the vapour experimented on and that of the vapour of iodine.

The following results have been obtained:—At 860° (Centrigrade) the density of sulphur vapour is 2·2, and remains about the same at a temperature of 1040°. Thus, the anomaly which was supposed to exist in the law of gaseous equivalents concerning sulphur disappears: when the density of sulphur vapour is taken at a temperature sufficiently remote from that of the point of ebullition of sulphur, the results are such that we may admit, without hesitation, that the equivalent 16 of sulphur represents 1 volume of vapour, as the equivalent 8 of oxygen represents 1 volume also.

The density of selenium vapour presents the same peculiarities as the preceding: at 860° it is = 8·2; at 1040° it is = 6·37. Theory indicates 5·44—a difference which it will require further experiment to elucidate.

The vapour of phosphorus at 1040° is 4·5. Theory gives 4·4 in admitting that 1 equivalent of phosphorus represents 1 volume of vapour. At 1040° the density of cadmium vapour is 3·94. By theory we obtain 3·87 in admitting that the equivalent of cadmium represents 2 volumes of vapour.

Bromide of aluminium vapour gave 18·62, theory = 18·5, 2 volumes; iodide of aluminium vapour gave 27·0, theory = 27·8, 2 volumes. These numbers were calculated by means of the apparent dilatation of air or iodine vapour in porcelain

[1] *Comptes-Rendus*, xlix. p. 239.

vessels, which do not sensibly augment in volume at the highest temperatures.

Iridium.—At the last meeting of the Academy of Sciences at Paris, M. Pelouze[1] presented some medals struck in alloys of iridium, consisting of: 1. platinum 80, iridium 20; 2. platinum 90, iridium 10; 3. platinum 95, iridium 5. These alloys were obtained at the demand of M. Jacobi, of St. Petersburg, by MM. Sainte Claire Deville and Debray.

The alloys in question can be rolled cold, and are easily tempered; they are harder than gold money at $\frac{916}{1000}$ths. This degree of hardness, and their capacity for resisting *aqua regia*, augments with the proportion of iridium. They are also capable of receiving a fine polish. The metals were obtained from a platinum ore extracted from the mines of Prince Demidoff, at Nijni-Tagilsk; this ore containing platinum 92·55, iridium 7, rhodium 0·45. The ore itself has been employed for medals, which are remarkable for their tenacity.

M. Jacobi[2] presented to the Academy a bar of iridium weighing 267 grammes, which was melted by MM. Deville and Debray in a crucible of lime, the combustible being a mixture of hydrogen and atmospheric air. In this experiment these authors substituted hydrogen gas for carburetted hydrogen (or common gas), which they employed in their experiments on platinum.

M. Regnault has determined the specific heat of this bar of iridium, and has found that the law of Dulong, which determines the relation existing between the specific heat and atomic weights of bodies is perfectly applicable to iridium. Former experiments tended to prove the contrary because they wer emade with impure samples of the metal in question.

On the Octahedric Oligist of Vesuvius.—The presence of crystals of oligist in the crater of Vesuvius, where they appear to result from sublimation, has often puzzled chemists. Some believe these crystals to have been formed by the sublimation of chloride of iron, which is afterwards decomposed into oxide, retaining the same form. Professor Rammelsberg[3] appears to have nearly solved the problem. The octahedrons of Vesuvius gave him on analysis:—

	I.	II.
Peroxide of iron	82·91	83·30
Magnesia	13·60	13·41
Oxide of copper	0·99	0·59
Insoluble portion	2·51	2·00
	100·01	99·30

The density of the sample I. was 4·568, and that of sample II. 4·638. Deducting the oxide of copper and the insoluble portion, these figures lead to the formula 2 MgO, 3 Fe_2O_3 or 3 MgO, 4 Fe_2O_3.

By heating together common salt and sulphate of iron, crystals of oligist are formed, and if the crucible be hermetically closed, magnetic oxide of iron in the form of a black powder is produced.

Magnetic oxide can also be obtained, according to M. Rammelsberg, by heating to redness some protochloride of iron in a glass tube, in presence of a current air and watery vapour. A black mass sublimes, which has a crystalline and at the same time cavernous aspect, and which is nearly pure magnetic oxide. Chloride of iron and chloride of magnesium being heated in the same conditions, Professor Rammelsberg obtained another black mass, which, after washing with water and acetic acid, gave the composition:—

	I.	II.
Peroxide of iron	67·46	69.00
Protoxide of iron	14·42	12·43
Magnesia	17.94	16·69
	99·83	98·12

This analysis conducts us to the formula 3 (MgO, FeO), 2 Fe_2O_3. The author explains by this experiment the production of the Vesuvian octahedrons, and proposes for them the mineralogical name *magnoferrite*.

[1] *Comptes-Rendus*, Dec. 5, 1859.
[2] *Ibid.*
[3] *Pogg. Annalen*, civ. p. 497; and *Comptes-Rendus*, xlix. p. 218.

II. ORGANIC CHEMISTRY.

New Colouring Matter.—M. Horace Kœchlin[1] announces that he has succeeded in obtaining a new, and, to all appearance, very important red colouring matter, by adding an acid (in preference hydrochloric acid) to a mixture of aniline and common pyroligneous acid. Wood-tar produces the same result as pyroligneous acid, which proves that acetic acid has nothing to do with the production of the colour. The substance obtained by M. Kœchlin somewhat resembles that lately introduced into commerce by M. Frank, and which has been called *fuchsine*; it is as yet, however, little known.

Gutta-Percha.—Professor Bleekrode[2] has lately presented to the *Société d'Encouragement pour l'Industrie Nationale* an interesting Notice on gutta-percha. [In the *Annales des Sciences Naturelles, Botanique*, vol. vii. p. 220, M. Bleekrode has shown that the commercial prices of this useful substance vary exceedingly. In the markets of Amsterdam, in 1857, they ranged from 7*d.* to 2*s.* 9*d.* the kilogramme (about 2lbs. English) on some 234,975 kilogrammes imported from the Dutch possessions of the East Indies. The consumption of gutta-purcha is increasing daily. "In the Dutch possessions," according to the author, "the exportation increases daily, whilst the imprudent manner of collecting the substance from the *Isonandra-percha* (at Singapore, an English possession) is gradually diminishing the production: in cutting down an Isonandra (*Njeto*) of 1 metre 50 in circumference, 160 grammes only are collected; whereas a tree that is only 90 centimetres in circumference furnishes at each bleeding, in the rainy season, 79 grammes, and in the dry season 138 grammes; being a total in one year of 217 grammes."

Another plant of the same variety, *Sapota Mulleri*, also furnishes a species of gutta-percha, which has been already tested in industry; it is collected easily without sacrificing the tree. The trunk is partially or totally encircled by a kind of clay basin, which collects the juice exuding from the incisions. At Surinam, this milky juice becomes solid in six hours. By testing it with alcohol, the author obtained from a specimen of this, which was rather spoiled during the voyage, 14·28 per cent of pure white gutta-percha.

Metals in the Blood.—M. Béchamp[3], of Montpellier, has communicated to the Academy of Sciences at Paris the results of some new analyses of blood, made with a view of ascertaining whether certain metals, such as manganese, copper, lead, &c. entered into its normal composition. He arrives at a negative conclusion, and asserts that these metals are only found accidentally in the blood, and do not constitute essential elements of its composition. It has been shown long ago, that iron is an essential element of this fluid; and, some years back, Dr. Hannon, professor of botany at Brussels, showed that the blood contains manganese, a discovery that has been since confirmed by other chemists. What proof have we then that M. Béchamp's analyses be the rule and not the exception?

III. CHEMICAL ANALYSIS.

Oxide of Copper for Organic Analysis.—Pure oxide of copper employed for organic analysis, is generally obtained by the calcination, in copper vessels, of nitrate of copper. In this manner, not only all the nitric acid is lost, but the abundance of nitrous vapours renders the operation disagreeable and unwholesome. MM. Vogel and Reischauer[4] propose a new preparation, as follows:—A solution of ammoniacal nitrate of copper heated to boiling point deposits black oxide of copper, whilst ammonia is evolved and neutral nitrate of ammonia remains in solution. An excess of copper is therefore dissolved in nitric acid, the solution, filtered or decanted

[1] *Répertoire de Chimie*, No. 12, 1859.
[2] *Bulletin de la Société d'Encouragement.*
[3] *Comptes-Rendus*, Dec. 5, 1859.
[4] D'Ingler's *Polytechnisches Journal*, cliii. p. 197.

off, is divided into two equal portions. To one of these, liquid ammonia is added until the precipitate which forms, is redissolved, and a clear blue liquid, $2AzH_3, CuO, AzO_5$, is obtained .The other portion is then poured in. A blue basic salt is precipitated, but enough ammonia remains in solution to transform this basic salt into oxide of copper when the liquid is heated to boiling. The ebullition takes place in the sand-bath, and black oxide of copper is deposited rapidly. The neutral nitrate of ammonia which remains in solution contains however a little copper, which gives it a blue tint. The metal is separated by sulphuretted hydrogen, and by evaporation the clear liquid furnishes pure nitrate of ammonia, a salt frequently employed for refrigerant mixtures.

Detection of Picric Acid in Beer.— Picric, or carbazotic acid, has often been employed to give a bitter taste to beer, and so economise the quantity of hop. M. Doré[1] informs us that Lassaigne's test will detect in beer the presence of $\frac{1}{15000}$ths of picric acid. It consists in adding subacetate of lead and animal charcoal to the beer in question, and shaking the mixture thoroughly. When the liquid has remained quiet for a little while, if the beer is pure it will be seen quite devoid of colour; but if even a very slight quantity of picric acid has been added to it, the liquid, after the above operation, will not lose its yellow colour.

SCIENTIFIC NOTES AND QUERIES.

Sir,—As one who has had a somewhat extensive acquaintance with chemists and druggists for many years, I firmly believe that a publication bringing before them new preparations, and giving trade hints and helps, would be warmly supported by them; and I hope a good portion of the Chemical News will be devoted to this purpose. Will you give insertion to the following in your *Notes and Queries*?—After making the underwritten prescription, and allowing it to stand a few hours, crystals are freely formed—(the patient tells me that she has had it made up to remain perfectly clear). What are those crystals? and how are they formed?

℞	Sodæ Sulphat.	ʒj.
	Magnes. „	℥ss.
	Ferri „	9j.
	Liq. Calcii Chlorid.	ʒij.
	Aquæ Font. ad	ʒviij.—Ft. Mist.

An answer will oblige.—*J. R.*

[The crystals are most likely sulphate of lime. Their formation may depend a little on the order in which the ingredients are mixed. The sulphates should first be dissolved in the whole quantity of *cold* water, and then the chloride of calcium may be added.—Ed.]

Determination of Phosphates in Soils, &c. — Sir,—Can you or any of your readers give me a good and easy process for the estimation of phosphates in soils and the ashes of plants? All the processes given in books are complicated or not satisfactory, and it may be some of your readers may know of better which they will be glad to communicate.—*H. D.*

Syrup of Iodide of Iron.—Sir,—A few weeks ago I made some syrup of iodide of iron in the usual way, which looked very nice, but was perhaps a little greener than usual. When, however, I come to dilute the syrup, in making a mixture there always falls a precipitate of small bright yellow crystals. What can these be? I am afraid to use it in dispensing until I know. *B. G.*

LABORATORY MEMORANDA.

To Gild Aluminium.—Digest a weak solution of chloride of gold with a little excess of lime for twenty-four hours. Well wash the precipitate of aurate of lime and lime, and then treat it at a gentle heat with a solution of hyposulphite of soda. The filtered solution can be used for gilding without the help of a battery. The aluminium must be previously freed from any oxide by successive washings with potash and pure nitric acid.

[1] *La Science pour Tous*, Dec. 1, 1859.

Detection and estimation of small quantities of Lead in the presence of other metals.—The separation of lead from its solutions and from other metals by means of chromate of potass, does not appear to have attracted the attention of analytical chemists to the extent which it merits, judging from the published special methods of analysis which include the determination or detection of that metal.

There are frequent instances in which the chromate of potassa offers considerable advantage as a precipitant of lead over hydrosulphuric or sulphuric acids, the two reagents in general use, more particularly for the detection of minute quantities.

The efficiency of this reagent is moreover much increased by the circumstance that chromate of lead is all but insoluble in acetic acid. It is indeed one of the most insoluble of the lead salts, and has, therefore, claim to superiority over the more soluble sulphate; whilst the scarcity of insoluble chromates renders chromate of potassa valuable for effecting the separation of lead from other metals in cases where the reagents referred to are inapplicable. The precipitation of lead in the presence of copper, for example, is more readily effected by the addition of bichromate of potassa to an acetic solution; a trace of lead which would otherwise escape detection is rendered evident after a time by the deposition of the characteristic yellow precipitate.

Bichromate of potassa in the presence of free acetic acid is also applicable as a means of separating small quantities of lead from zinc (*i.e.* in the analysis of the spelters of commerce). The precipitation of lead by hydrosulphuric acid from the hydrochloric solution, is at times anything but satisfactory, the solubility of the sulphide of lead in the excess of hydrochloric acid which must be employed to prevent the precipitation of the zinc is sufficient to lead frequently to the belief that lead is absent when it really exists in the spelter to a very appreciable amount. (It may be observed that this liability to error, in the use of hydrosulphuric acid, is not nearly so great when nitric acid is employed).

If much bismuth be present in the substance under examination, some chromate of bismuth will be precipitated, together with the lead. In such instances the separation of the two metals must be effected by a special method.

The chromate of lead when freshly precipitated from a cold solution is sometimes difficult to separate perfectly from the liquid by filtration; this is not the case, however, if the precipitate is allowed to stand for some time, or if it is produced in a hot solution.

The most accurate way of determining the weight of minute quantities of lead precipitated as chromate, is to convert the metal finally into sulphate. For this purpose the chromate is dissolved in a little hot dilute hydrochloric acid; a small crystal of tartaric acid is added, and the solution, rendered alkaline by ammonia, is treated with hydrosulphuric acid, or mixed with a few drops of sulphide of ammonium. The sulphide of lead thus obtained is washed and converted into sulphate by the usual method.

Chemical Department, Woolwich.

ANSWERS TO CORRESPONDENTS.

A Novice.—1. The processes "are equally efficacious for the extraction of the virtue from the Sarsaparilla." That made by the second method would keep best — but it is not a *decoction*. 2. It would not spoil for a week or two, if kept in a bottle *quite full*, and well corked. Left open to the air, most decoctions and infusions will spoil within a week in winter, and two days in summer, and sometimes in much less time. 3. An ounce of rectified spirit to the pint would probably answer, but it would be absurd to add it to any other than a concentrated infusion or decoction.

Prescription.—If not directed, "or to saturation," the dispenser would have no right to put more than the quantity of alkali written. Citric acid is now often prescribed in excess.

X. Y. Z.—We cannot undertake to recommend wholesale houses. Our correspondent must find his market for himself.

A Junior.—It is got rid of perfectly by boiling, but this boiling must be continued for some time.

M. P. S.—(London.) To answer your question might subject us to trouble which we do not care to incur, but the fact is as stated in the note. It would be difficult, if not impossible, to detect the fraud, which perhaps increases the criminality.

Ph.—The oil will always separate, and the mixture must be shaken before it is used.

M. B.—Chloric Ether, so called, is not an ether, but a solution of chloroform in spirit. It is kept of various strengths, there being as yet no recognised formula. Mr. Haselden has shown that a mixture of one part chloroform and nine parts spirit is the most convenient to employ.

W. J. S.—Try the yellow prussiate and pernitrate of iron.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks on Parkes's Method for the Estimation of Copper by means of Cyanide of Potassium, together with a brief Review of the Modes usually adopted for the Determination of Copper, by FREDERICK FIELD.

[FIRST PART.]

IN one of the numbers of the *Mining Journal*, in the year 1851, Mr. Parkes published a method for the volumetric determination of copper, by means of a standard solution of cyanide of potassium. The process is so well known, and has been so generally adopted, that a detailed account of the *modus operandi* would be unnecessary. The substance containing copper is dissolved, ammonia added in excess, and solution of the cyanide dropped carefully into the dark blue liquid until the colour disappears.

Towards the latter stage of the process, however, the decolorisation is not very distinct, the solution assuming a delicate violet tint, which fades very gradually, leaving at length the liquid destitute of colour. Great caution and considerable practice are required to determine the necessary amount of cyanide. There can be no doubt that it is requisite to allow the liquid to stand for some time (a quarter of an hour or twenty minutes) towards the close of the operation; and if the colour is not expelled after that period a few drops more cyanide must be added, the flask well agitated, and the solution once more left at rest. Indeed, it is always safer to leave a very slight tint, as it disappears after the lapse of twelve or fourteen hours. Since the publication of Mr. Parkes's method, I have made considerably more than fifteen thousand estimations of copper by the cyanide process, comparing it with many other well-known modes of determination, in order to test its accuracy, and to observe the influence which solutions of other metallic oxides possess when in conjunction with that of oxide of copper.

In the case of copper ores, containing copper either combined with sulphur, as disulphide or protosulphide; with sulphuric acid, as *brochantite* or *cyanose;* with oxygen, as suboxide or protoxide; with carbonic acid, as the *blue and green basic carbonates;* with chlorine, as *atacamite;* with phosphoric acid, as *tagilite*, &c.; as arsenide in *Domeykite* or *algodonite*, and with arsenic or arsenious acid, provided no iron be present; in alloys of copper and tin or copper and antimony; double sulphides of copper and iron, either as yellow or blue pyrites, the copper can be estimated with exactness by cyanide of potassium.

Now, in all copper ores containing iron, it is far better to add the cyanide to the ammoniacal solution, *without filtering off the suspended peroxide of iron.* Every chemist knows with what tenacity this oxide holds an ammoniacal solution of copper. Even after several hours washing with warm liquid ammonia, the copper cannot be separated; and although the liquid may pass through colourless, on rewashing, after a day or two, the filtrate will have a decided blue tint. The test first proposed, I believe, by Mr. Warington (and which, decidedly, is the most delicate one for the presence of copper which we possess), viz. ferro-cyanide of potassium, never fails to show the presence of copper in the peroxide of iron, even when hydro-sulphuric acid or ammonia are unable to detect it. If a small quantity of copper with a large excess of iron be dissolved in nitric acid, a considerable quantity of ammonia added, and the two metals separated by filtration, after washing for several days, on taking a small portion of the oxide of iron, dissolving in hydrochloric acid, adding ammonia and filtering, a drop of the ferrocyanide added to the filtrate in a white capsule, is sure to give a pink stain on the porcelain, when the excess of ammonia has been expelled by a gentle heat. There is no need whatever for filtering off the oxide of iron, and the estimation of copper can be effected in a very satisfactory manner without undergoing filtration.

In copper slags, for example, which generally contain from 0·2 to 0·8 per cent. of copper, and from 40 to 50 per cent. of iron, it is impossible to determine the former metal, with any degree of accuracy, by the addition of ammonia and subsequent filtration. Cyanide of potassium added to the liquid in which the oxide of iron remains suspended, is capable of estimating the amount of copper with considerable exactness. A rim of liquid, more or less blue, gradually appears above the precipitating oxide, a few drops of the standard decolorising solution are added, the whole well agitated, and allowed to rest, until the clear liquid reappears. If still strongly coloured, more cyanide is required, and this operation is continued until the liquid has a pale violet, or rather, rose-coloured tint. It is then left for some time, and if the shade do not seem to fade, a small quantity more is added. The result of numerous estimations prove, that small quantities of copper can be determined very successfully by this means; and when several slags or other metallurgic products have to be examined, the method is very convenient, as, while the oxide of iron is subsiding in one flask, another assay can be undergoing decolorisation from the burette, and so on.

In order to test the accuracy of the process, two or three experiments may be cited from among a great many which have been made. A mineral containing simply sulphur, iron, and copper, with a little quartz, gave in five determinations: —

	31·4	per cent. Cu.
	31·5	" "
	31·3	" "
	31·4	" "
	31·4	" "
or a mean percentage of	31·4.	

Four estimations were made by precipitating the copper from the solution of its oxide in hydrochloric acid, by means of metallic iron: —

	31·38	per cent. Cu.
	31·42	" "
	31·47	" "
	31·44	" "
Mean	31·427.	

Two determinations were effected by the precipitation of the copper as sulphide by means of hydrosulphuric

acid, and subsequently weighing as protoxide in the usual manner:—

Cu calculated from CuO 31·384
" " " " 31·402
Mean 31·393.

These experiments prove that copper may be estimated with considerable exactness by means of cyanide of potassium.

In each determination, 50·000 grains of mineral were taken, and the solution of cyanide formed by dissolving 1300 grains of the salt in four pints of water. A solution of this strength may be kept many days without undergoing decomposition, although it is always better to make a preliminary experiment, from time to time, in order to see that the standard is the same.

In alloys of *tin and copper*, the copper may be determined without difficulty.

In alloys of *antimony and copper*, the copper can be estimated with ease.

In the case of *arsenic and copper*, the latter metal can be determined very readily. A specimen of *Domeykite*, given to me by its discoverer, M. Domeyko, yielded by this process 71·6 Cu, M. Domeyko finding 71·64, and theoretically, 71·91 (Cu_3As). And it may here be remarked that the cyanide of potassium does not in any way interfere with the estimation of the arsenic. In fact, it rather facilitates the determination, as the washing of the arseniate of ammonia and magnesia ($2Mg.O.NH_4O.AsO_5+HO$) is more easily effected from the ammoniacal cyanide of copper than from the solution of cupric oxide in the volatile alkali. When arsenic acid and copper exist together in a liquid, the addition of ammonia in excess still holds them both in solution, and when sulphate of magnesia is added, the ammonio-magnesian arseniate is precipitated. It very seldom happens that this precipitate can be entirely freed from copper even by prolonged washing. If the arsenic exists in in large quantity, a resolution of the arseniate in hydrochloric acid, and reprecipitation by ammonia, is almost always imperative. But, by the addition of cyanide of potassium to the ammoniacal liquid, as described above, until the blue colour disappears, sulphate of magnesia causes a precipitate which can readily be washed free from copper, as the cupro-cyanide of ammonium is far more readily removed than the blue compound. In this case, therefore, two precipitations are avoided. It must not be forgotten, however, that when *iron* is present, as well as arsenic and copper, cyanide of potassium fails to determine the amount of the latter.

Arsenic acid is produced by the solution in acids, arseniate of iron is formed, and this compound being soluble in ammonia, forming a brown liquid, of course vitiates the result. Mr. Parkes proposes the addition of sulphate of magnesia to the ammoniacal solution, previous to the application of the cyanide, by which means the double arseniate of magnesia and ammonia is formed as well as oxide of iron. This mode of procedure I have found to answer very well.

Alloys of *Copper and Zinc*. Cyanide of potassium is valueless for the determination of copper when zinc is present. More of the standard solution is required, the excess depending upon the quantity of zinc which may exist. All kinds of brass, &c. cannot, therefore, be examined by this process for the amount of copper they may contain. When cyanide of potassium is added to an ammoniacal solution of the oxides of zinc and copper, two beautiful crystalline compounds are produced. One of these compounds appears in the form of large light blue crystals belonging to the regular system; the other of snow white needles of great lustre. Both are perfectly insoluble in water, and have not, I believe, been thoroughly examined.

Alloys of *Silver and Copper*. The presence of silver also prevents the estimation of copper. In fact, in an ammoniacal solution of these metals, the cyanide of potassium seems to form compounds with the silver in preference to the copper. Cupro-cyanide of ammonium is decomposed by silver salts. When hydrocyanic acid or a soluble cyanide is added to a solution of a salt of copper in a considerable excess of ammonia, until the liquid is perfectly colourless, the addition of nitrate of silver restores the deep blue colour, and an argento-cyanide of silver, or of silver and copper, is formed. There are a great variety of beautiful compounds consisting of silver, copper, cyanogen, and ammonium, which have not been examined—one especially can be produced by very careful evaporation, in splendid dark blue octahedra, having great lustre, and containing more than 60 per cent. of silver. Another compound separates in pearly scales containing a larger proportion of copper.

Both *nickel* and *cobalt* interfere greatly with the determination of copper by cyanide of potassium.

Manganese and Copper. Mr. Parkes informs us that manganese interferes with the estimation of copper, but its action may be prevented by using the carbonate of ammonia instead of the caustic alkali, and boiling for some time. This may prevent the interference of manganese to some extent, but the results I have always found to be more or less vitiated, and that in a very remarkable manner. It will be observed that in the above solutions of other metals with copper, an excess of cyanide has to be employed, and this is easily accounted for, as the oxides of zinc, silver, cobalt, and nickel, are soluble in ammonia, and thus they exert an action more or less intense upon the cyanogen, preventing that element from combining directly and entirely with the copper. But in the case of oxide of manganese, *less* cyanide is required instead of *more* as with the other metals. Thus, for instance, if 1000 grain measures of solution decolorise 5 grains of copper, 1200 or 1300 are requisite to decolorise 5 of copper with 3 of zinc, or silver, or nickel, but not more than 800 or 900 are necessary to decolorise the same quantity of copper when an equal amount of manganese is present. The free carbonate of potash in the commercial cyanide of potassium precipitates partially the oxide of manganese from its ammoniacal solution, or the result would be still more striking. Two experiments may be cited, one was made upon an artificial compound of 5·00 grains of copper, and 5·00 grains of peroxide of manganese, and the other upon a mineral which I described some time ago in the *Chemical Gazette* a double silicate of manganese and copper, consisting of:—

Water	16·09
Protoxide of copper	27·00
Peroxide of manganese	34·41
Silica	22·16
	99·66

In the first instance 894 grains decolorised the liquid perfectly, no change in appearance took place after some weeks standing. Now, as 1000 grains solution=5·00 copper, 894 grains=4·47 copper, making an apparent loss of more than 10 per cent. of that metal.

In the second case, the numbers seen in the analysis are the result of many careful determinations by precipitation of the copper as sulphide, and estimation as oxide, but cyanide of potassium only gave evidence of 23·8 per

cent. and 23·9 per cent. copper, or about 11 per cent. less than the mineral contained.

I have vainly tried to obtain crystalline ammoniacal cyanides of manganese and copper, an analysis of which might help to explain this phenomenon. It is probable that a colourless compound of these two metals exists; but on evaporation most of the manganese falls as oxide.

In concluding this part of the subject, it may be said that cyanide of potassium is well adapted for the estimation of copper in some few alloys, and for all ores consisting either of copper in combination with various non-metallic elements, or associated with iron, and that the method is susceptible of great accuracy after bestowing the amount of care always necessary in analytical research. Other methods for the estimation of copper will be discussed in a future number.

TECHNICAL CHEMISTRY.

Description of a Patent Blast Gas Furnace, by J. J. Griffin, *F.C.S.*

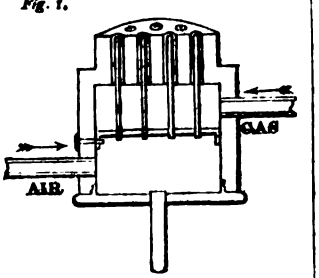
The Patent Blast Gas Furnace consists of two parts, namely, of a particular form of gas-burner, which is supplied with gas at the usual pressure, and with a blast of common air, supplied by bellows or a blowing machine, at about ten times the pressure at which the gas is supplied.

Secondly, of a Furnace, which is built up in a particular manner, round the flame that is produced by the gas-burner, and the crucible that is exposed to ignition. The object of the particular construction of this furnace is to accumulate and concentrate in a focus the heat produced by the gas flame, and to make it expend its entire power upon any object placed in that focus.

This apparatus can be made of various sizes, according to the amount of work which is required from it. We describe below a few varieties of the furnace, and the results of some experiments made with them, which will show the reader what kind of work it is able to execute.

The Gas-burner.—The gas-burner is a cylindrical iron reservoir, containing two chambers, which are not in communication with one another. Into the upper chamber, gas is allowed to pass; and into the lower chamber, air is forced by means of tubes. The upper part of the burner is an inch thick in the metal. Through this solid roof, holes are bored for the escape of the gas. The experiments described hereafter were made with a burner that contained sixteen holes; but burners with six holes, and with twenty-six holes, have been made for other purposes. The number of holes depends, of course, upon the heating power required from the burners. The air passes from the lower chamber, through a series of metal tubes, placed in the centre of the gas-holes, and continued to the surface of the burner, so that the gas and air do not mix until both have left the gas-burner, and then a current of air is blown through the middle of each jet of gas. The bottom of the gas-burner is made to unscrew, and the division between the two chambers, which carries the air-tubes, is easily removable, for the purpose of being cleaned. The gas and air pipes are both half an inch in the bore, and are ten inches long; the gas has usually had a pressure of half an inch of water, and the blast of air about ten times that pressure. The quantity of gas used in an hour was about 100 cubic feet. The stopcock which supplied it had a bore of half an inch.

Fig. 1.



When the gas is lighted and the blast of air is put on, the flame produced by the gas-burner is quite blue, and free from smoke. It is two inches in diameter, and three inches high, and the point of greatest heat is about two inches above the flat face of the gas-burner. Above this steady blue flame there rises a flickering ragged flame, several inches in height, varying with the pressure of the gas. In the blue flame, thin platinum wires fuse readily.

When the gas is burning in this manner, and the apparatus is attached to flexible tubes, the burner may be inverted or held sideways, without disturbing the force or regularity of the flame, so that the flame may be directed into a furnace at the bottom, the top, or the side, as circumstances may require.

The following articles are used in building up the gas furnace for different experiments. They vary in size according to the volume of the crucible, or the weight of the metal which is to be heated.

1. A circular plate of fire-clay, two inches thick, with a hole in the centre, which exactly fits the upper part of the gas-burner, which is made to enter into the hole three-quarters of an inch. In external diameter, this clay plate agrees with each size of furnace.

2. A cylinder of fire-clay, of which two pieces are required to constitute the body of each furnace. In the middle of each cylinder, a trial-hole is made, one inch in diameter, to which a fire-clay stopper is adapted.

3. A fire-clay cylinder, closed at one end, and pierced near the open end with six holes, of half an inch in diameter. The thickness of the clay is immaterial.

This cylinder is three inches high and three inches in diameter.

4. A circular plate of fire-clay, two and a half inches or three inches in diameter, and one inch thick. Similar pieces half an inch thick are useful.

5. A cylinder of plumbago, to be used as a crucible support. It is three inches inside diameter and one inch in height. It is pierced with twelve holes of three-eighths of an inch bore.

6. A similar cylinder of plumbago, two inches high, pierced with twenty-four holes of three-eighths of an inch bore.

7. A thin plate of plumbago, three inches in diameter, namely, of the same diameter as the above three cylinders. It has a small hole in the middle, and being of soft material, the hole can be easily cut or filed to suit crucibles of any desired size.

To suit the larger kinds of crucibles and furnaces, cylinders are made resembling the above in form, but of greater diameter.

As in all cases the heating power of the gas furnace spreads laterally, and does not rise vertically, the most advisable form of the crucibles required for use in it is *short and broad*, not tall and narrow, and the supporting cylinders must be shaped accordingly. No fire-bars or grates can be used to support crucibles in this gas furnace, because no material, formed into narrow bars, can sufficiently withstand its powers of fusion and combustion.

8. A plumbago cylinder, or crucible-jacket, two and a half inches high, two and a half inches in diameter, and

a quarter of an inch thick in the walls. It has six holes of three-eighths of an inch diameter near one end.

9. A circular cover or dome, flanged at the bottom, and having a knob or handle at the top. It is pierced with twenty-four holes of a quarter of an inch in diameter, arranged in two rows near the bottom. This dome, when of small size, is made of plumbago. When of large size, of fire-clay.

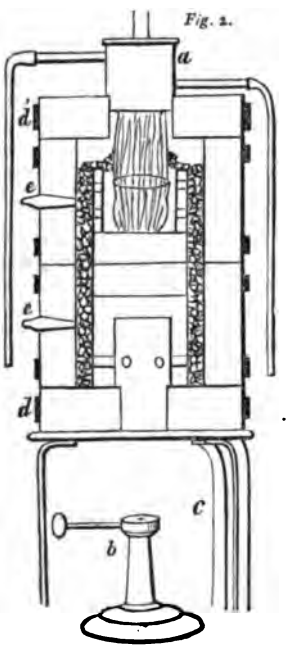
10. Plumbago crucibles made with a solid overhanging rim, the use of which is to suspend the crucibles over the gas-burner, by means of the cylinders, Nos. 5 and 6. When the crucibles are too small to fit the cylinders, the flat plate (No. 7) is filed to fit the crucible, and is then placed on the cylinder, to whose diameter it is adapted.

Besides these pieces of fire-clay and plumbago, it is necessary to be provided with a strong iron tripod, to sustain the furnace; an iron pan, in which to place the furnace; and a quantity of gravel, or rounded flints, not less than half an inch, nor more than one inch, in diameter. These pebbles form an essential part of this gas furnace.

Gas Furnace, heated at the top, exhibited in section by fig. 2.—*a* is the gas-burner (fig. 1); *b* is the support for it, when used below the furnace; *c* is the iron tripod support for the furnace; *d d* are two perforated clay plates (No. 1) adapted to the gas-burner *a*; *e e* are two clay cylinders, like No. 2. These pieces, *a* to *e*, are similar in all the furnaces, and will not require description in each example.

The interior of the furnace, as represented by fig. 2, is built up as follows:—The clay plate *d*, is put upon the tripod *c*. Over the central hole in *d*, the clay cylinder (No. 3) is placed, and upon that cylinder two or three of the clay plates (No. 4). Upon these a porcelain or platinum crucible is placed. If it is of platinum, a piece of platinum foil may be put between the crucible and the uppermost clay plate, to protect the crucible from contact with particles of iron, or against fusion with the clay. The crucible is to be covered by the plumbago jacket, No. 8. The space between this pile in the centre of the furnace and the two cylinders *e e*, which form the walls of the furnace, is to be filled with flint stones, or gravel, washed clean and dried. The stones which answer best are rounded, water-worn pebbles, of half an inch to one inch diameter. These may be piled up to the top edge of the jacket (No. 8). The number of clay plates (No. 4) must be such as to bring the top of the crucible to the distance of two inches, or two and a half inches at the utmost, from the flat face of the gas-burner *a*. In some cases, merely one of the furnace cylinders *e*, is necessary, in which case the crucible and its jacket is placed directly upon the cylinder (No. 3), and when only a moderate heat is required, even the packing with pebbles may be dispensed with. Another means of diminishing the heat is that of increasing the distance between the gas-burner and the crucible.

Fig. 2.



The apparatus being thus arranged, the gas is to be turned on, and to be lighted, the blowing-machine is to be put into action, and the nozzle of the gas-burner is to be depressed into the central hole of the clay plate *d*. The whole force of the blue flame then strikes the crucible; part of it forces its way through the holes in the jacket (No. 8), and part of it rises and passes over the upper edge of the jacket; after which it forces its way downwards between the pebbles. The carbonic acid gas and the vapour of water which result from the combustion of the gas, together with the nitrogen of the air, and any uncombined oxygen, accompany it. No space being left open for the escape of these gases at the upper end of the furnace, they go downwards through the interstices among the pebbles, and passing through the holes in the cylinder (No. 3), and through the central hole in the lower plate *d*, they escape finally into the air. In this progress the hot gases give up nearly all their heat to the flint stones. Water and gases escape below at a very moderate temperature, water even runs down in the liquid state, while the stones rapidly acquire a white heat, and if the blast and the supply of gas is continued, they retain that white heat for any desired length of time — for hours.

At the end of ten minutes after lighting the gas, the crucible, placed in the described circumstances, and exposed to the full action of the heat of the gas, and surrounded by substances which are bad conductors of heat, is raised, with the jacket and pebbles around it, to a white heat. The consequence is, that the full power of the gas jet is then exerted upon the crucible and its contents, and those effects are produced which will be described presently.

If it is desired to inspect the substances subjected to the action of heat in this furnace, the gas-burner is lifted out, and the crucible is examined through the hole in the clay plate. To make it possible to inspect substances at a white heat, the view is taken through a piece of dark cobalt blue glass. If the substances submitted to heat suffer no harm from the action of oxygen, it is better to dispense with a crucible cover, and to direct the jet of flame directly down upon the substance to be heated. The action is then more rapid. When the burner is taken out, the substance in the crucible can be stirred, if it is considered necessary.

The following experiment will give an idea of the power of a furnace of this description. A common clay crucible, three inches high and three inches diameter at the mouth, was filled with about 24 ounces of cast iron. It was mounted as in fig. 2, in a furnace of four inches internal diameter, and eight inches deep. The pebbles were filled in to the edge of the crucible. No crucible cover and no jacket were used. The flame was thrown directly upon the iron. In a short time, the iron melted, the oxygen then converted some of the cast iron into magnetic oxide of iron, which formed a thin, infusible mass, on the surface of the cast iron. At twenty minutes from the lighting of the gas, the furnace was dismounted. The crucible was taken out. A hole was broken by an iron rod in the infusible surface of oxidised iron, and the fused cast iron below it was decanted into a mould, and made a clear casting weighing twenty ounces.

In the same small furnace 32 ounces of copper can be

fused in 15 minutes. When the furnace is hot, that quantity of copper or cast iron can be fused in 10 minutes.

In a furnace of the same dimensions, but with a gas burner having only six, instead of sixteen jets, 16 ounces of copper or of cast iron can be completely fused, in ten minutes if the furnace is cold, and in seven minutes if the furnace is hot.

These experiments show that within twenty minutes a heat is producible in this little furnace which is more than sufficient for the decomposition of silicates by fusion with the carbonates of potash, soda, or barytes.

(To be concluded in our next.)

PHARMACY, TOXICOLOGY, &c.

Chemical Researches on the Essential Oil of Valerian, by M. Pierlot, *Pharmacien.*[1]

In a note presented to the Academy of Sciences, the author had already demonstrated the pre-existence of valerianic acid in fresh valerian root, and had shown the uselessness of the means recommended for developing it in the oil extracted from the plant. He has since examined the oil to discover what principles it contains, and to establish by new experiments that not one of them is capable of becoming transformed into valerianic acid.

The oil of valerian has been made the subject of investigation by several chemists. Among others, Grote, who discovered valerianic acid; Ettling and Kraps, who supposed it to have the same composition as oil of turpentine; Gerhardt and Cahours, who detected in it an oxygenated oil and a hydrocarbon. Lastly, in the seventh volume of the *Annales de Chimie et de Physique*, 1843. Gerhardt published an important article on the subject, and his conclusions have been generally adopted in all recent works on chemistry. In this remarkable work, the author points out some capital errors.

As well as the acid, some chemists have denied the pre-existence of the oil in the plant. According to the partisans of this opinion, the oil is formed secondarily in the same way as oil of bitter almonds. Some experimenters allowing the free access of air, evidently could not obtain the volatile principle. M. Bouchardat having distilled the tincture of the dried root, found neither oil nor acid. The root exhausted by alcohol, treated again with water, and again distilled furnished none; and hence the learned professor concluded that, as these principles had not passed over with the alcohol in which they were soluble, and could not be found in the water, they did not exist in the plant.

The fallacy of the first experiment is seen at once. Alcohol is entirely evaporated at 78° C., while the acid in solution requires 110°, and the oil 120° degrees; and therefore the alcohol passes over leaving these bodies in the residue, where they must be sought for.

That the oil does pre-exist in the plant is proved by the following experiments:—

If one of the radicles is simply crushed on a piece of white bibulous paper, an oily spot is produced.

The distillation of the fresh root with water gives an oil varying in colour, according to the sort of plant used. It is green when obtained from the wild valerian, and yellow when got from the cultivated plant. From whichever obtained, however, its characters do not sensibly differ in other respects. It is very fluid, and gives off a strong penetrating odour like that of the root; its taste is disagreeable, and a little sour; its specific gravity at 10° C. = 0·936. It reddens litmus paper strongly. Exposure to the air removes the greater part of its hydro-carbon, and some of the valerianic acid and water it contains; at the same time the oxygenated oil thickens and is converted into a green resin.

The oil boils at 200° C. A temperature of −40° does not congeal it; but about −150 white flocculi form, and rise to the surface, which, when removed, change to an oily liquid, having the odour of valerianic acid, of which the flocculi are composed.

The oil of valerian does not combine with either caustic potassa or soda.

Cold nitric acid colours it blue; if the mixture be slightly heated, nitrous vapours are disengaged, and at the same time the oil is changed into a blue resin, which is heavier than water, soluble in ether, insoluble in alcohol and caustica potassa, agreeing in these respects with the resin obtained by distilling the oil, and that extracted from the dried root.

When submitted to a simple distillation, the fresh oil gives at from 120° to 200° C. a yellow, oily, limpid, transparent liquid, which is only the oil a little impaired by the operation. This product contains nearly all the acid of the oil; its colour becomes deeper by keeping.

If the heat be raised to from 200° to 300°, a limpid transparent oil of a bottle-green colour is obtained, which is sensibly acid. Exposure to the air, as well as successive distillations, transforms it into a green resin; nitric acid, on the contrary, converts it into a blue resin.

If, after removing the product of this second fractionation, the heat be continued to from 300° to 400°, a thick oily, opaque substance of a greenish colour, passes over containing traces of acid. This is completely changed into resin of valerian by the action of nitric acid.

The two last products, green and blue, mixed and distilled together, give between 200° and 280°, a very fluid, transparent, slightly green, oily body, smelling like hay or the camphor of the labiatæ: this is the *valerol* of Gerhardt. It contains still a little acid. Redistillation renders it colourless, and makes the odour softer and sweeter. Gerhardt calls this *neutral rectified valerol*. It is important to remark that it can only be really rectified by distilling it in contact with a strong base, which will remove the acid it always contains. In this way only we obtain a neutral product which no influence will change into valerianic acid.

During the last distillation, between 200° and 280°, there condenses in the retort tube a crystalline volatile matter smelling like camphor: this is the stearoptene of valerian to which we shall presently return.

Such are the different bodies obtained from the oil, simply by means of heat, and we see that valerianic acid is always present, and is found even in the last products of decomposition.

If now we distil the freshly prepared oil off solid potassa, in a tubulated retort furnished with a thermometer, gradually increasing the heat up to 200°, there passes an almost colourless oil, which smells something like oil of turpentine. At 200° the distillation stops spontaneously. Some aqueous vapour is disengaged, and the oxygenated oil retained by the potassa concretes, and assumes an odour like camphor. The result of this first distillation is the hydrocarbon ($C_{20}H_{16}$) contained in the

[1] Pharmaceutists long ago found out an easier and cheaper way of making valerianic acid than distilling it from the root; but the other products have an interest, especially as one has been recommended for admission to our already encumbered *Materia Medica*.—Ed.

oil. In this operation, which I have often repeated, I have never observed the crystalline matter which Gerhardt sometimes met with; it is only above 210° and at the expense of the oxygenated oil that this body is produced, as we shall see further on. Gerhardt gave the name *borneene* to the hydrocarbon, but I prefer to call it *valerene*. When it is pure it boils at 160°, and evaporates without leaving a residue.

The valerianic acid originally contained in the oil is combined with the potassa; but the oxygenated oil has by no means produced it, as Gerhardt wishes to show.

If now, after having changed the receiver, we continue to heat the oil which was solidified on the potassa, it gradually liquefies, and begins to distil at 210°; boiling directly that temperature is reached. At 280° the distillation stops again, and we have in the receiver a thickish, slightly coloured, neutral oil, containing an abundance of solid camphreous matter, which gives to it a strong smell like hay. This oxygenated oil is the *valerol*.

Exposure to air thickens and resinifies it, but, contrary to the assertion of Gerhardt, does not develope any acid. It is the same with other oxidising agents, such as bichromate of potassa and binoxide of manganese, the influence of neither producing any reaction on litmus

Valerol absorbs a good deal of ammoniacal gas without forming a salt, another proof that it does not contain the acid. It continues to boil from 210° to 430°, showing that it has no fixed boiling point.

The steareoptene of valerian ($C_{34}H_{20}O_8$)—the crystalline camphreous matter which we have found in the valerol—condenses in great abundance in the neck of the retort. At the same time a little water is disengaged, most likely from that part of the valerol which is resinified. There remain in the retort a green resin (C_2H_2O) and some valerianate of potassa, but I have never found this salt in the residue of the rectification of *valerol* over potassa. In the latter case no oxidising agent can produce any other than the elements we have mentioned, viz. the steareoptene of valerian, resin, and water. MM. Gerhardt and Cahours are, therefore, in error when they say that valerol becomes changed into valerianic acid.

The foregoing may be considered as an exact analysis of oil of valerian, 100 parts of which contain:—

Valerene			25
Valerianic acid			5
Valerol	Steareoptene of valerian	18	70
	Resin	47	
	Water	5	
			100

The preceding facts, I believe, prove: 1. That the essential oil *does* pre-exist in the fresh plant; 2. That, fresh or old, it always contains about 5 hundredths of valerianic acid; 3. That rectified over potassa it is perfectly neutral; 4. That it contains two oils: the one a hydrocarbon ($C_{20}H_{16}$) or *valerene*, which is neutral, and volatilises entirely, leaving no residue; the other oxygenated or *valerol* ($C_{34}H_{20}O_8$), also neutral, becoming resinified in the air and by the action of nitric acid, and decomposing into several bodies; 5. That the valerol is composed of the steareoptene of valerian, resin, and water; 6. That valerol cannot be changed into an acid by any (known) process.—*Annales de Chimie et de Physique.*

On a Modification of the Chlorate of Potash method for the Oxidation of Organic Matter in the Detection of Mineral Poisons, by Geo. Thos. Glover.

Of all the processes which have as yet been proposed for the oxidation of organic matter in substances supposed to contain mineral poisons, perhaps none has been found to attain the object more perfectly than that in which the material is treated with powdered chlorate of potash and hydrochloric acid. One very serious objection to this process, however, arises from the large quantity of chloride of potassium, necessarily produced by the decomposition of the chlorate of potash, by the hydrochloric acid, and the subsequent difficulties which we have to encounter, either from the crystallisation of this salt or from the quantity of water required for its solution. In order to overcome this difficulty, I would propose the following modification of the process, which I have found to answer exceedingly well in practice. I introduce into a large flask a quantity of chlorate of potash, about 3 or 4 ounces, in crystals, as I find that when the salt is powdered the action is too sudden. The flask is provided with a cork, through which pass two tubes, one a long funnel-tube to permit of the addition of hydrochloric acid from time to time, and the other bent twice at right angles, in the usual manner, so as to permit of the passage of the gas produced through the liquid to be operated upon. I now pour through the funnel-tube hydrochloric acid, of about sp. gr. 1·05, that is, one part of the ordinary pure concentrated acid and two parts of water. Heat is now applied to the flask, and the gases which come over are passed through the material which we wish to oxidise, and which must be rendered liquid enough for the purpose by the addition of water. I find the process to answer better if the beaker containing the liquids be removed between the renewals of the hydrochloric acid, when the gas has ceased to come, and boiled. The funnel-tube, intended for the addition of the acid, serves likewise as a safety-tube, and must be made sufficiently long to prevent the column of liquid, which will be forced up some height in it by the pressure of the gas, from passing over at the top. This tube likewise, by admitting atmospheric air at the proper time, prevents the liquid in the beaker from being carried back into the flask, an accident which is otherwise rather apt to happen towards the close of the disengagement of the gas. I believe that an india-rubber stopper, provided with holes for the reception of the tubes, such as are manufactured by the Messrs. Macintosh, would answer better for the flask than a cork, being less liable to oxidation. I am quite aware that it has been already proposed to oxidise the organic matter in such liquids by passing a current of chlorine gas through them, but I believe that the process above described will be found much preferable.

Sheffield.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY. *Thursday Evening, December 15th.*

Dr. W. A. Miller *in the Chair.*

A short paper was read by Dr. Moldenhauer, *on the Production of Starch*, in which the author commented upon the arguments derived from the animal and mineral kingdoms in support of the view that the ordinary form and structure of starch granules were to be accounted for by the coalescence of atoms under circumstances antagonistic to their deposition as regularly formed bodies or crystals. Dr. Moldenhauer instanced the transformation of recently precipitated carbonate of lime, which left to itself under water, gradually passed from an exceedingly fine state of division to larger particles, and these eventually assumed the crystalline form of calc-spar; but by rendering the surrounding liquid mucilaginous and more dense by the admixture of

gummy substances, this direction of change was prevented, and small spherules or dumb-bell shaped concretions were now the result of the altered conditions of transformation. The several stages in this and other examples referred to were illustrated by a diagram and by microscopical preparations.

Dr. Gladstone having made a few remarks upon the question generally, and on the explanation of the somewhat analogous shell and bone structures, a passing inquiry was elicited in the course of discussion, as to whether "cohesion" or "gravitation" would be the proper term to apply to the force exerted between neighbouring particles of the same kind of matter.

Professor C. L. Bloxam then gave the results of a very elaborate series of experiments instituted by him for the purpose of ascertaining the capabilities of a system of electrolysis as applied to the detection of arsenic and other mineral poisons contained in organic mixtures. The lecturer commenced his remarks by disclaiming any intention of offering as an original suggestion the recommendation of the employment of the galvanic battery in medico-legal inquiries. He was aware that former attempts had been made in this direction, but not finding such a process in common use, he was led to the present investigation in the hope of being fortunate enough to surmount some of the difficulties which beset such a mode of experimental inquiry. After enumerating the disadvantages of Marsh's test, particularly the consideration that so large an amount of sulphate of zinc, and possibly traces of other metallic compounds, became admixed with the suspected materials, which, in the event of arsenic not being detected, stood in the way of *the same portion* of substance being employed in the search for other poisons, and also to the circumstance that in Reinsch's test copper was necessarily introduced, Mr. Bloxam proceeded to point out the great recommendation of a galvanic system of operating to depend on the circumstance that by its adoption *no foreign metal* nor other chemical reagent capable of affecting the subsequent tests could possibly in this way become intermingled with the suspected liquids. The form of apparatus first employed by him for the detection of traces of arsenic consisted of a U tube holding diluted sulphuric acid, into each limb of which was inserted a small platinum plate connected with the wires of a Grove's battery of five cells. Above the pole from which the hydrogen was eliminated, a cork and hard glass tube, bent and drawn out to a narrow orifice, were adapted so as to allow of the escaping gas being exposed to a high temperature. It having been ascertained that the materials were pure, a small quantity of an arsenical solution was introduced, when it was found that this metal made its escape with the hydrogen and was again deposited as a mirror in the cooler part of the heated delivery tube,—this result following the employment of no more than one-hundredth part of a grain of arsenious acid. A mixture of organic matters was then prepared by macerating together bread, meat, eggs, beer, and milk, with the intention of imitating the undigested contents of a stomach, and to this dark brown liquid the several poisonous compounds were added. The metals included in the plan of examination were arsenic, antimony, copper, mercury, bismuth, and zinc; and of these the two first were evolved with the hydrogen (antimony sometimes, however, being precipitated also as metal), whilst all the others were usually deposited on the platinum plate attached to the negative pole of the battery. These metals could afterwards be dissolved off and separated by digesting the incrusted platinum plate in either yellow sulphide of ammonium, nitric acid, or other convenient solvent, and the ordinary analytical indications of each metal observed. It was remarked that a small quantity of arsenic in the form of its highest oxide was more difficult of detection than when in the state of arsenious acid, and its reduction by means of sulphurous acid was therefore recommended; it was observed also that mercury had the power of masking the indications of arsenic.

Mr. Bloxam exhibited an improved form of apparatus in which his later experiments had been conducted. It consisted of a goblet containing diluted sulphuric acid and a small platinum plate, as the battery terminal, immersed in it; a short tubulated glass cylinder, of about two ounces capacity, with a porous diaphragm of vegetable parchment closing the lower, wide mouth of the same, and also containing diluted sulphuric acid, was placed within the goblet; while its contracted neck was fitted with a cork and hard glass tube drawn out to a narrow jet, and a second platinum plate was suspended within the cylinder in connection with the zinc end of the battery. Such an arrangement would be ready to receive the suspected fluid (poured into the small cylinder), or the product obtained by concentrating to a small bulk the poison contained in the heterogenous matters commonly submitted to medico-legal investigation. A scheme for effecting this separation formed the concluding portion of the paper. Its general features consisted in the destruction of the interfering organic substances by treatment with hydrochloric acid and chlorate of potassa, as recommended by Fresenius and Babo; and afterwards reducing the arsenic acid so produced by means of sulphite of soda. The liquid was then concentrated over a water bath to about one or two ounces, and introduced, with a little alcohol to prevent frothing, into the decomposing apparatus. Along with the hydrogen, arsenic and usually a small quantity of the antimony, would escape, and be deposited again in the heated tube; there was little probability of confounding these two metallic mirrors, for the antimony, less volatile, condensed in the glass tube nearer to the source of heat. The larger quantity of the antimony was however thrown down in company with the other metals on the platinum plate.

In the interesting discussion which followed the reading of the paper, Mr. Alfred Smee stated that he considered that too much stress could not be laid on the advantage of employing a decomposing *force* like electricity, to separate the poisonous metals in preference to analytical systems which required the consumption of large amounts of chemical reagents. The subject of the electro-deposition of arsenic was not new to him, as was shown by referring to some of his published statements regarding that metal. By the employment of a battery of low power, arsenic was reduced to the metallic condition, but with such a powerful apparatus as that employed by Mr. Bloxam he had always found it to be evolved as the hydrogen compound. With regard to the electro-deposition of zinc, he found that the conditions of rough and smooth surfaces would entirely determine whether any metal was reduced, for if in Mr. Bloxam's apparatus a platinised or roughened platinum plate were employed, no zinc could possibly be thrown down, even though a large quantity of that metal existed in solution. Also, if several metals in the same liquid were submitted to electrolysis, particularly where a weak current was employed, they would be deposited in a definite order of succession, and should there be nitric acid in the solution, it would be destroyed before any metallic salt could suffer decomposition.

Dr. Letheby had repeatedly made experiments on various suggested means of applying electricity to the detection of arsenic, but considered the advantages at present as very problematical. When large quantities of all kinds of organic matters required to be reduced to a condition suitable for the application of specific chemical tests, he considered the hydrochloric acid and chlorate of potash system quite inadequate to accomplish the destruction of the great mass of materials then to be dealt with. It was very desirable to limit as far as possible the number and quantity of the chemical agents employed, and he much preferred to employ concentrated sulphuric acid with a little nitric, and by carbonisation of the organic matters, to reduce the bulk of the substances under experiment. There was little fear of losing arsenic by the temperature required to accomplish this; he had actually carried on the process until incineration commenced, without appreciable loss of arsenic. The process he should prefer to adopt in the case of a suspected stomach would consist first, in straining off any insoluble portions, and examining these apart from the rest, and looking in

them especially for arsenic. It should then be digested with alcohol, and this solution decomposed by basic acetate of lead, to effect the separation of the organic acids and other bodies, afterwards discoverable by precipitating the lead by sulphuretted hydrogen, and treating the residue obtained on evaporation with different solvents, ether, chloroform, &c. In this way a poisonous organic substance was sure to be discovered if present, and its effects could be tried on animals, even if the specific name of the poisonous body were not identified. The alcoholic treatment should be followed with water and acids, and these solutions, after destroying organic matter, subjected to a stream of sulphuretted hydrogen; a precipitate, would be sure to form; which when collected could be examined for arsenic and other metals by the ordinary processes. Before the presence of arsenic were definitely pronounced it should be made to furnish both the copper and silver compounds, the reduced metal and the alliaceous odour. Dr. Letheby considered that Reinsch's test could be applied in the course of this examination, for, if the absence of copper had been proved by preliminary experiments, it often afforded a useful indication of mercury and arsenic, which were then sure of detection.

Dr. Odling had great confidence in Reinsch's test, if the proper conditions were secured; he considered, however, that the boiling of the hydrochloric acid solution of arsenic, or the tantamount proceeding of acting with sulphuric acid upon animal matters containing chlorides should be avoided, since this might be attended with the production of a small quantity of volatile chloride of arsenic. In consequence of the action within the system of sulphuretted compounds on any arsenious acid administered, a certain amount of tersulphide of arsenic was likely to be formed, which although but sparingly soluble in hydrochloric acid, was nevertheless sufficiently so for the purposes of detection. He deprecated the practice, in judicial cases, of placing in the hands of the jury a small sealed tube exhibiting a minute arsenical mirror or a microscopic crystalline dust, and contended that the chemist's judgment should be relied upon equally with his experiments, and that a statement of his conclusions should be considered as evidence more impartial than that of trusting the uneducated jurymen to decide upon the nature and contents of the closed glass tube produced in court.

Mr. Bloxam in reply to some of the objections urged in discussion, considered that the sulphuric acid preferred by Dr. Letheby for the destruction of organic matter had all the disadvantages which that gentleman attributed to hydrochloric acid, for this latter was, in the process of manufacture, only likely to be contaminated by the impurities contained in sulphuric acid, and was from its more volatile nature the more susceptible of purification.

Dr. Miller, before moving the adjournment of the meeting, considered that the discussion of a subject of such general interest as that which had just now been brought before them, was likely to prove of the greatest value; and that he wished it emphatically to be understood that the conclusion to be derived from so many phases of opinion as had been expressed that evening, did *not* justify the idea that the indications of analytical chemistry were at all doubtful, or that any difficulties existed in the way of detecting arsenic or other poisons. Such an erroneous impression would be fraught with the most dangerous consequences, if allowed to be misconstrued by the public as being the result of discussion at a meeting of the Chemical Society; for, as all chemists must be aware, we are possessed of most accurate means for their detection and discrimination, and although it is probable that no two operators would follow exactly the same track, there is no doubt that each would arrive at an equally successful result; and it is therefore only a question as to which is *the best* among the many processes at command.

The meeting then adjourned until Thursday, the 19th of January, 1860.

NOTICES OF BOOKS, PATENTS, &c.

A Handbook of Chemical Manipulation, by C. Greville Williams, late Principal Assistant in the Laboratories of the Universities of Edinburgh and Glasgow. Van Voorst: London.

The great progress which has been made in all departments of chemistry of late years, has been owing in no small degree to that fertility of invention, and that scrupulous attention to the most minute details which distinguish the workers in this science. The methods and apparatus of modern chemistry, seem indeed more varied than those required by any of the other experimental sciences. The microscope, the polariscope, the prism, the goniometer, the barometer, the galvanic battery, instruments borrowed from other departments of physics, now render most important aid to the chemical investigator; while in addition, conspicuous improvements have been made in the instruments peculiar to his science, as in furnaces for attaining with ease the highest temperatures, and in gasometrical apparatus.

It is remarkable that while new manuals of analytical and descriptive chemistry are continually produced, no adequate account of modern chemical manipulation was in existence when Mr. Greville Williams's comprehensive handbook appeared. Faraday's treatise on the same subject, full of useful hints and happy contrivances, had then been long out of print, and we may congratulate ourselves on possessing so worthy a successor to it in Mr. Williams's book. Young students not yet initiated into the processes of the laboratory, more advanced workers, and those engaged in original research, will alike find useful information in its pages. The talented author has introduced and described many new processes and contrivances, originated or improved by himself during the course of his investigations. The sections on the use of the balance, on specific gravity, on vapour densities, on filtration, on supports for apparatus, on operations at high temperatures, on distillation, on determination by the burette, and on the manipulatory details connected with organic analysis, are clearly and carefully written. The young student who has not had the advantage of laboratory instruction, will find it easy, by the help of Mr. Williams's descriptions and drawings, to construct any kind of apparatus that he may require. The sections on glass working and on miscellaneous operations will afford to every one engaged in chemical experiment much useful information, the result of long and varied practical experience. There is one feature of the Handbook to which we would direct particular attention, namely, the account of processes and reactions employed in researches, in which the most characteristic and typical answers are given. This is an invaluable boon, especially to those about to conduct original investigations in organic chemistry, and who do not enjoy the constant advice and assistance of an instructor well versed in this branch of the science. It is the first time too that such information has been presented in a systematic and comprehensible form, freed from those specialities which generally accompany the first announcement of any new process or reaction.

Mr. Greville Williams's *Handbook of Chemical Manipulation* is an authority to which we are glad to refer even the beginner, for he will find there concise accounts of the preparation of the more common elementary and compound gases and of the construction and use of the simplest forms of apparatus, and may then become gradually accustomed to technical expressions, to more elaborate contrivances and more recondite processes. It is a book which should be among the works of reference in every public laboratory, and in the library of every chemist. The type is excellent, and the woodcuts, upwards of 400 in number, the best representations of chemical apparatus that have yet appeared in an English work. A copious index, and the tables appended to the volume, enhance its value considerably. We have no redundancies to complain of, and the omissions which we

have been able to detect, are very few and comparatively unimportant, and will no doubt be rectified in a new issue. In taking leave of the Author, we give him our best thanks for his excellent and unique treatise, of which we hope he will have to prepare a second edition before long.

Improvements in Treating and Purifying Gutta Percha. Thomas Cattell, M.D., 12 *August*, 1859.

It is hard to say from reading the specification, what the patentee does with the gutta percha; but it would appear that he first cleanses it by the ordinary process of mastication and washing, and then dissolves it in one of two classes of volatile solvents, in the proportion of 1 part by weight to about 15 parts of the solvent. The two classes of solvents are: 1, those which require the assistance of heat to effect the solution, or, as the specification sets forth, those "whose solventicity bears a ratio and relation to elevation of temperature," such as coal-tar naphtha and its rectified products, turpentine, and other hydrocarbons; and 2, those which easily take up gutta percha in the cold, as bisulphuret of carbon and chloroform. When treated by one of the first class, preference being given to benzole, the patentee adds at the same time the gutta percha and the solvents are brought in contact, one ounce of alcohol holding 30 drops of glycerine in solution to each gallon, or one ounce of alcohol holding 30 grains of soap in solution, or one ounce of pyroxylic spirit holding 30 drops of glycerine in solution, or one ounce of spirit of nitre. The object of this addition is to precipitate the colouring as well as feculent and insoluble matters combined with the gutta percha. The solution is made in a close vessel, heated to about 110° F., and it is then allowed to stand 24 hours to defecate. It is now decanted from the dregs, and is afterwards either exposed for the solvent to evaporate, which is called "the process of congelation," or the solvent is distilled off and saved, or the gutta percha is precipitated from the solution by adding to it an equal measure of alcohol (methylated or not) about 65° overproof, or anhydrous pyroxylic spirit, or fusel oil. In the last case, the mixed fluid is stirred for a few seconds, allowed to stand for a short time, and is then drawn off, leaving the gutta percha ready for use.

The specification does not say what the patentee proposes to do with the mixture of alcohol or pyroxylic spirit and benzole obtained in the last operation.

Whatever may be thought of the process, it seems to answer most perfectly in the hands of the inventor. The specimens we have seen are of the purest white. It may be also drawn in threads, which possess wonderful strength when compared with ordinary gutta percha.

Improvements in treating certain Ores, and in obtaining products therefrom, by William Henderson. 1859.

The improvements relate:

First, to the treatment of zinc ores, or other ores containing zinc:

Secondly, to the treatment of ores of antimony that contain lead, and several other metals:

Thirdly, to the treatment of copper ores:

Fourthly, to the treatment of ores or products containing cobalt:

Fifthly, to the treatment of gold and silver ores and auriferous quartz; and lastly to the dressing or concentrating of lead and other ores.

In treating zinc ores, the inventor first calcines the ore, and then dissolves out the zinc by means of weak hydrochloric acid. If the ore contains much lead, he uses very weak acid. If it contains little lead or copper, he precipitates them with scrap iron or sulphuretted hydrogen, or the lead is separated by sulphuric acid. The zinc is then precipitated as carbonate by continuous boiling with carbonate of lime, and the carbonate is reduced to the metallic state in the usual manner.

In the treatment of the ores of antimony containing lead, and several other metals, the ore is first calcined with a weight of common salt equal to the antimony it contains, air being freely admitted to the furnace; whereupon it will be found that the whole of the antimony, with some arsenic, iron, and other metals, distil over in the state of chlorides. These the inventor condenses by passing them up a tower filled with coke or pebbles, with a small stream of water trickling down. Before, however, they pass up the tower, they are conveyed through a tube, kept at a red heat, into which is introduced a small steam jet. In this way the chloride of antimony is converted into the oxide and hydrochloric acid, which pass on to the tower and are condensed. The oxide of antimony is reduced in reverberatory furnace with charcoal or any other reducing flux; and the metals left after the distillation of the chlorides are reduced by any known means.

The treatment of the ores of copper refers especially to the poor sulphurets. These are first calcined, so as to remove the whole of the sulphur. The copper is now dissolved by means of hydrochloric acid, and afterwards precipitated from the solution by iron. The iron is then removed by caustic lime, and the acid is recovered from the chloride of calcium by a process already patented by the inventor.

To separate cobalt from chloride of iron liquors, the inventor evaporates the neutral solution to dryness; and then converts the chlorides of iron into oxides by means of heat and steam, whilst the chloride of cobalt remains unchanged, and may be dissolved out by boiling water. To obtain the cobalt free from zinc or any of the earths or alkalies, the solution is boiled with a strong solution of bleaching powder, and the black precipitate is washed with dilute sulphuric acid, which leaves the cobalt pure.

Gold ores the inventor divides into two classes, — the first consisting of gold ores properly so called, and the second of auriferous quartz. The first class of ores are smelted (with copper ore if necessary) to obtain a regulus. Two or three tons of this regulus are fused with two parts of anhydrous sulphate of soda and one part coal. When the ore is poor in gold, this mixture must be thoroughly mixed with the melted regulus. After the mixture is made, the heat is continued for an hour or more; the slag is then skimmed off, and the melted regulus tapped into sand moulds in the usual manner. While the pigs of metal are still hot they are thrown into water, which disintegrates them like quicklime, dissolving out the sulphuret of sodium holding in solution the sulphuret of gold. The sulphuret of gold is precipitated from this solution on the addition of a mineral acid to excess, and it is then collected and reduced. The residual copper regulus is used over and over again with fresh gold ore. Auriferous quartz the inventor first calcines and then treats with muriatic acid which does not contain any free chlorine. After standing a few hours, he washes away the muriatic solution until the water is tasteless. He then covers the quartz with aqueous solution of chlorine, which dissolves the gold at once, or at all events in the course of twenty-four hours. Sometimes the inventor mixes peroxide of manganese with the ore before he adds the muriatic acid, and after twenty-four hours he washes out the solution of gold and precipitates the metal by protosulphate of iron.

To concentrate lead and other ores, the inventor simply grinds them in an ordinary corn mill, set so as not to pulverise but only to rub the particles together, and then sifts them through sieves of different degrees of fineness. The first one should be very fine, and from this only ore of the first quality will be obtained, and the inventor finds that the matrix generally leaves the second sieve so poor as to produce ore of no value in a third sieve.

Improvements in the re-working of Compounds of India-rubber and Sulphur, by William Hooper. 1859.

In the manufacture of india-rubber there is a great deal waste. This waste the inventor hardens by heat, and then grinds it to powder, after which he adds a quantity of raw

india-rubber or other substance to make the powder adhere together, and a small proportion of sulphur. He then moulds the compound to any form desired, and heats it to make the hard or semi-hard substance formed by heating such mixtures. By mixing a larger quantity of raw india-rubber with the ground material and employing less heat, a substance something like ordinary vulcanised india-rubber may be obtained.

We should have thought that a plan of this sort would have been followed by every manufacturer of india-rubber.

CORRESPONDENCE.[1]

The Jacob Bell Testimonial.

To the Editor of the CHEMICAL NEWS.

SIR,—No man ever deserved a testimonial more than Jacob Bell, the only question about it can be what form it shall take. A scholarship in the gift of the Pharmaceutical Society must be generally approved of, for the School of the Society may be said to be of Mr. Bell's creation. But if enough money be obtained, I would suggest a plan which would give a wider interest to the testimonial, and would perhaps do more to promote the study of Pharmacy. Let the society offer an annual, biennial or even triennial prize (like the Jacksonian at the College of Surgeons) for the best essay on some pharmaceutical subject and let it be open to the competition of all chemists and druggists. A scholarship has often brought the career of a very promising student to an unsatisfactory close, and the publication of the essay will always prove that the prize was fairly earned. I write this suggestion in the interest of the Pharmaceutical Society of which in most things I am a warm supporter.

M. P. S.

Chemical Notices from foreign sources, by Dr. T. L. PHIPSON.

I. MINERAL CHEMISTRY.

Perchloride of Phosphorus.—M. R. WEBER[2] has shown that a certain number of natural and artificial oxides are decomposed easily by perchloride of phosphorus (PCl_5) with production of corresponding metallic chlorides and oxychloride of phosphorus. Silicic acid obtained by calcination of the gelatinous silica, is decomposed at a red heat by perchloride of phosphorus; a volatile liquid condenses in the recipient. This liquid decomposes water, producing acid vapours and a precipitate of gelatinous silica; it is probably a mixture of oxychloride of phosphorus and chloride of silicium. Stannic acid and titanic acids are decomposed in the same manner.

With alumina oxychloride of phosphorus is formed, whilst near the red-hot tube is condensed a combination of chloride of aluminium with protochloride of phosphorus ($Al_2Cl_3 + PCl_3$). M. Weber has also obtained this combination directly by the union of the two chlorides. It is almost colourless, fusible, and more volatile than either of its constituents.

Chrome-iron, franklanite, spinel, and other minerals are attacked and decomposed at high temperatures by perchloride of phosphorus. The oxides of cadmium, manganese, cobalt, magnesia, and chromium are also transformed into chlorides when slightly heated in PCl_5. With oxide of iron a double chloride $Fe_2Cl_3 + PCl_3$) is formed as with alumina. This double chloride can also be produced by mixing together the two chloroides. Arsenious, iodic, arsenic, and molybdic acids are decomposed by PCl_5 at the ordinary temperature of the atmosphere.

Artificial production of Azurite.—The mineral azurite has for formula $3CuO.2CO_2.HO$. It has been obtained artificially by M. Debray[1] in the reaction of nitrate of copper in solution upon common chalk. The experiment is made in tubes closed at the lamp, and the decomposition takes place at the ordinary temperature and under the slight pressure of three or four atmospheres. The chalk is observed to become covered first with a green matter, which soon transforms itself into crystals of azurite. The following reactions take place:

1st. $3\,(Cu.NO_5) + 2\,(CaO.CO_2) = 3\,(CuO.)\,NO_5 + 2\,(CaO.NO_5) + 2\,CO_2$.

2nd. $3\,(CuO)\,NO_5 + CaO.2\,CO_2.HO = 3\,(CuO),\,2\,CO_2,\,HO + CaO.NO_5$.

The carbonate of lime cannot be replaced by a soluble alkaline carbonate. When bicarbonate of soda is heated in a closed tube with nitrate of copper to 160° (Centigr.) a blue crystalline compound is obtained, insoluble in water, and which is $CuO.CO_2 + NaO.CO_2$. This is the first example we have of a double anhydrous carbonate of copper non-decomposable by water. M. Becquerel produced azurite artificially two years ago by means of electricity. His paper was communicated to the Paris Academy of Sciences.

Peroxide of Lead.—Since peroxide of lead (PbO_2) is employed in the fabrication of lucifer matches, it is prepared on a large scale. Professor Boettger[2] proposes that it should be manufactured by boiling acetate of lead with a clear solution of chloride of lime in excess. In this reaction, peroxide of lead, chloride of calcium, and acetate of lime are formed. The peroxide is washed until it contains no chloride.

This process is only a modification of that of M. Winkelblech, who has shown that salts of lead boiled with an alkaline hypochlorite, produce peroxide of lead. The latter made use of hypochlorite of soda, but chloride of calcium being quite as soluble as chloride of sodium, it is more economical to employ Prof. Boettger's process.

PbO_2 can also be obtained by passing a current of chlorine gas into water, holding oxide of lead in suspension ($2\,PbO + Cl = PbO_2 + PbCl$), or into water mixed with oxide of lead, and an alkali or quick lime ($PbO + CaO + Cl = PbO_2 + CuCl$). It is prepared likewise when oxide of lead is melted with a mixture of chlorate and nitrate of potash.

II. ORGANIC CHEMISTRY.

Cahilose.—M. Payen[3] has submitted to a chemical examination, the substances contained in the birds' nests which are used by the Chinese as an aliment, and form among the Oriental nations the object of a large commerce. These nests, as is well known, are constructed by a species of swallow, which the French term *Salangane*. The quantity of nests exported yearly from the Indian archipelago is estimated at 242,000 lbs. English. The value of the substance is from 100 to 150 francs a pound. In Paris, these swallow nests sell sometimes as high as 400 francs a pound, or 5 or 6 francs per nest. They are sold ready for eating. Many naturalists think that the nests are composed of the spawn of fish, or of a mixture of various zoophytes; others think they are made of a certain juice which exudes from some unknown tree, or that they are constructed with lichens and gelatinous algæ. It appears certain, however, that the swallows produce at the time of nidification a mucilaginous liquid, secreted from their salivary glands, or by the glands of one of their stomachs, in the same manner that the swallows of Europe secrete a viscuous liquid with which they cement together the materials of their nests in the window corners of our houses.

M. Payen's investigations show that such is the case; the agglutinative and alimentary principle of the Salangane's nest sometimes forms the greater part, or even the whole of the nest, and is a peculiar secretion analogous to animal mucus containing nitrogen (9·52 per cent) and *sulphur*, devoid of organisation, sinking in water, and dissolving almost entirely in hot water, taking an orange colour with iodine, soluble in diluted and warm alkaline solutions, &c. To this

[1] As the space we can allow for correspondence is necessarily limited we shall not always be able to publish the letters of correspondents at full length. It will always, however, be our object to give a fair epitome of their contents.

[2] *Monatsbericht der Königlichen Preussischen Akademie der Wissenschaften*, Feb. 1859, p. 129.

[1] *Repertoire de Chimie*, Novembre, 1859.

[2] *Polytechnisches Nothblatt*, 1859.

[3] *Comptes Rendus*, Oct. 1859.

new immediate principle, the author has given the name of *cubilose*, which implies the use and natural state of the secretion in question.

Gelose.—M. Payen[1] has likewise given the name of gelose to another principle, which he has extracted from the *Gelidium corneum* or *Java alguæ*, and from a certain commercial substance known as "Chinese moss" (*mousse de Chine*), which is employed in China to prepare jelly, &c. Gelose is extracted from the substances in question by cold water: when dissolved in boiling water the whole is transformed into a jelly on cooling, and in this manner *one part of gelose will transform 500 parts of water into jelly*; weight for weight this new substance has 10 times more gelatinous properties than isinglass. It is insoluble in alkaline solutions, in water, alcohol, ether and weak acids. It dissolves in concentrated sulphuric and hydochloric acids, and forms a brown substance which gelatinises, and resists both hot and cold water, and solutions of caustic alkalies.

Fixation of Colouring Matters.—M. Bolley[2] of Zurich has been studying for some time past, the action of colouring matters upon various tissues, to discover whether their fixation is owing to chemical affinity, capillarity, &c. He appears to have shown that capillarity has nothing to do with the phenomenon, for, amorphous cellulose precipitated from a solution of cellulose in Schweitzer's liquid "combines" with mordants, and with colouring matters (or at least *fixes* them), and can be separated from them again by the ammoniacal solution of cupric oxide. Mr. Bolley has arrived, after various experiments, at the conclusion that tissues fix colouring matters in the same manner as charcoal does, but with less energy. Hence the necessity of employing *mordants*, which form (chemically?) with the soluble colouring principles, *insoluble* lakes which water cannot wash away. The author admits that the mordant is in *chemical* combination with the colour, whilst the latter, together with the mordant, is only *mechanically* fixed upon the tissue as it would be upon charcoal, when precipitated by this agent from a solution. We may observe here, that up to the present time the attraction of charcoal for colouring matters has not been satisfactorily explained.

III. CHEMICAL ANALYSIS.

On the means of detecting sophisticated Milk.—Such is the title of a long paper recently published by M. Delarue[3], of Dijon. The author discusses the value of the various instruments, lactometers, galactometers, lactodensimeter, cremometers, &c. invented for testing the purity of milk, and he shows in a very satisfactory manner that they are perfectly useless and can in no way be relied upon. He endeavours to prove also that chemical analysis is not capable of detecting in every case whether a sample of milk has been sophisticated or not. This may be, for instance, when water has been added to milk which is extraordinarily rich in butter, caseum, &c. Analysis is, however, the only means in our opinion that can be at all relied upon. A sample of milk from the Alps was brought to me a short time ago to be examined. Analysis gave

Water	86·67	
Butter	3·96	solid matter.
Sugar of milk	4·00	
Fixed salts	0·50	13·33 per cent.
Caseum, &c.	4·87	
	100·00	

This result coincides so closely with analysis of good cow's milk cited by Berzelius, Lassaigne, Wöhler, &c. that I did not hesitate to pronounce it of good quality. It would certainly be going backwards were we to depend entirely upon *the taste*, as M. Delarue proposes, in order to test the purity of a sample of milk.

[1] *Comptes-Rendus*, Oct. 3, 1859.
[2] *Moniteur Scientifique*, 1859, No. 71, p. 425.
[3] *Schweitzer's Polytechnische Zeitschrift*, 1859.

Detection of Arsenic in Organic Matters.—Some discussion has taken place before the Paris Academy of Sciences, as to whether nitric acid and nitrates or sulphuric acid should be employed to destroy the organic matter in a medico-legal search for arsenic. On the 3rd of October last, Mr. Leroy[4] brought forward some facts to show that in Marsh's apparatus arsenic cannot always be detected when sulphurets are present or when sulphurous acid is in the liquid. According to the author these compounds are formed when sulphuric acid is employed; he therefore proposes nitric acid or saltpetre in many cases. On this occasion M. Gaultier de Claubry[2] stated that nitric acid and nitrate of potash cannot be employed as he has shown in his *Traité de Chimie Légale*, that it is impossible to detect sulphurous acid in the black matter resulting from the action of sulphuric acid, although this product (So_2) was admitted to be generally present by Orfila; finally, that it is easy to avoid any error resulting from the production of sulphur spots, or spots produced by metallic sulphurets by adding nitric acid or aqua regia to the decomposed mass produced by the sulphuric acid.

M. Filhol[3], of Toulouse doubts the assertions of M. Gaultier de Claubry, and appears to vindicate M. Leroy's opinions. But MM. Batard and Regnault[4], observe that the question was resolved some time since in one of their reports (1844), in which it was shown that nitric acid and nitrates presented causes of error, and that in most cases sulphuric acid alone could be employed to carbonise the organic matter.

SCIENTIFIC NOTES AND QUERIES.

Gunpowder and its Improvement.—Sir,—In a recent number of the *Daily Telegraph*, the editor, when writing on the subject of gunpowder, hopefully alluded to the time when an ounce might be made to go as far as a pound of the present make. I am afraid we shall have to wait a long time before that will be realised. Many attempts have been made by myself and others in that direction, at a considerable risk. In fact, very strong powders are decidedly objectionable on many grounds; such as the difficulty of making artillery to withstand their action; their extreme danger in handling, and their explosion being likely to recoil with more tremendous effects on those who use them—to say nothing of their unequal expansion and deficient propulsive power or range, as instanced in the case of gun cotton, and compounds of chlorate of potash, with their liability to ignite more readily by friction and percussion than ordinary powder, compared with which the latter is far safer.

The utmost improvement and increase of strength in ordinary powder which can be desired, combined with safety, would be 25 to 35 per cent.; and this I have obtained without the use of any chemical agent, and of which the following example will afford some idea:

Having constructed a target of sound pine wood, free from knots, consisting of eight boards, 1½ inch thick, firmly bound together, Minié balls were fired from a rifle at the distance of 40 yards, the penetration into the solid mass being about 2 inches deeper than with the best government rifle powder, the latter penetrating only the fifth board; whilst mine (or the government powder improved by me) went clean through the sixth and into the seventh board—a pretty strong proof of the improvement effected by the addition of the harmless ingredient alluded to.

But, Sir, the difficulties and prejudices against the introduction of all improvements to the authorities are so great as to deter any inventor, however sanguine he may be of success, from coming forward to disclose his secret and spend his money, unless he is thoroughly satisfied of having a full and fair trial of his invention—disappointment being the common lot of most inventors, notwithstanding the official reports of the trials are in their favour. Trotman's anchor, Prideaux's cooling furnace doors, to wit, *cum multis aliis* that I could mention. The admitted superiority of a thing is not always a passport of its introduction to use; there

[1] *Comptes-Rendus*, Nov. 7, 1859.
[2] *Idem.*
[3] *Idem.*
[4] *Idem.*

are, perhaps, other causes which operate, which the inventors are not supposed to know, or ever can arrive at. In my case, I can fearlessly say that, since the day when gunpowder was first invented, no greater power, combined with corresponding safety, has ever been obtained, or perhaps ever will. Inventors are too often hardly dealt with, and their inventions snubbed and laid aside for awhile dormant, until some one of more tact and cunning re-introduces them under other auspices and other guises and claims the merit of novelty. Indeed, if the statement of the *Engineer* of some few months since be true, as many as 4000 inventions per annum are rejected; whether on sufficient grounds, or not, parties are left to judge for themselves; but so it is—*experientia docet.—John Horsley, F.C.S.*

Cheltenham.

Detection of Metallic Poisons by means of the Battery.—Sir,—In answer to "Medicus," p. 12, I may inform him that Osann has employed a battery for the detection of very minute quantities of arsenic. He dilutes a solution of arsenious acid in hydrochloric acid with water until sulphuretted hydrogen no longer gives a yellow precipitate. He then places a few drops of this solution in a watch glass, and exposes it to the action of a small coke battery. A dark coating of metallic arsenic is soon perceptible at the negative pole. The plan, I have no doubt, might be used in organic mixtures, and would, I think, be superior to Reinsch's method. In the case of arsenic, however, I do not see the advantage of being able to detect such very minute quantities, at all events for legal purposes. Juries, with very good reason, refuse to hang a man on the strength of a few microscopic crystals.—*Expert.* [See also Mr. Bloxam's paper in the report of the meeting of the Chemical Society, which we publish this day.—Ed.]

Note on the Murexide Dyes.—In the process for the employment of the murexide dye for printing, given in the last issue of your journal (page 17), there is a precaution to be attended to which I think of sufficient interest and importance to find a place in connection with the statements of Dr. Von Kurrer. If silk be the material operated upon, and it be printed crimson by the process referred to, there is a great tendency for a certain quantity of mercury, derived from the corrosive sublimate bath, to remain in the fabric as an insoluble compound, and equally impregnating the printed and the preserved white portions of the goods; and will, in the course of time, most assuredly give rise to yellow stains and discoloration—appearing first at the folds, where in packing they are more freely exposed to the sulphuretted contaminations of the atmosphere. An occurrence of this kind having been presented to my notice, I was led to make some experiments, with the view of ascertaining the best method of removing the mercury compound without interfering with the brilliancy of the crimson dye; and in this I succeeded by the use of a final bath of tartaric acid. The goods were passed through a course of treatment similar to that described by Dr. Von Kurrer, for the production of the crimson or rose-red dye, but were found, as I said, still to contain mercury, which no washing would remove; they were then steeped for a short time in tartaric acid solution (8 ounces to 1 lb. of the crystals dissolved in a gallon of cold water), and finally washed. This agent removed from the fabric nearly all the mercury; and the distinction between the state of the goods before and after purification was, on testing with sulphuretted hydrogen, brought out in a very conspicuous manner.

The murexide preparation is supposed to be manufactured from guano: it has a dark red colour, and very much resembles powdered cochineal; the selling price is about 20*s.* per lb. There are also in the market other varieties, of French manufacture, selling at a somewhat higher rate; they are well crystallised, exhibit dichroism, and may be procured in slightly-varying shades of colour.—*John Spiller, F.C.S.*

Chemical Department, Woolwich.

Purification of Water by means of Metallic Iron.—Sir,—In the last number of the Chemical News, in an article on "Why do ships rot?" you state that M. Kuhlmann found that the hydrated oxide of iron "agitated with water, coloured by various organic matters, energetically decolorised it; a fact which led you to suppose that it might be a valuable agent in the purification of waters for the supply of towns." Perhaps you may not be aware that the fact of iron—metallic iron—being a purifier of water is already known. The most impure waters are completely decolorised by the precipitation of all the vegetable and animal impurities therein contained by simple contact with that metal, and by subsequent filtration of the organic matter. Indeed, the principle has been patented, and filters are now being sold which, thanks to chemistry, are not merely strainers, but scientific *disinfectants.—Thos. Salter, F.C.S.*

LABORATORY MEMORANDA.

Coloured Flames.—Bibulous paper soaked for ten minutes in a mixture of 4 parts by measure of oil of vitriol with 5 parts of strong fuming nitric acid, and then washed out thoroughly with warm distilled water, is to be dried at a gentle heat. The gun-paper thus prepared is then saturated with chlorate of strontium, with chlorate of barium, or with nitrate of potassium, by immersion in a warm solution of these salts; a solution of chlorate of copper also may be used. If, after complete drying, a small pellet of any of these papers be made, lighted at one point at a flame, and then thrown into the air, a flash of intensely-coloured light is produced, while the combustion is so perfect that there is no perceptible ash. The barium salt gives a beautiful green light, the strontium-salt a crimson, the potassium-salt a violet, and the copper-salt a fine blue. The chlorates may be prepared sufficiently pure for these experiments by mixing warm solutions of the chlorides of barium, strontium, or copper, with an equivalent quantity of a warm solution of chlorate of potassium. The clear liquid is to be poured off the precipitated chloride of potassium, and employed for the saturation of different portions of the gun-paper. The foregoing makes an admirable lecture-experiment, for illustrating the colours of the barium, strontium, and other flames.—*A. H. Church.*

To determine the amount of Alcohol in Wines and other Alcoholic Mixtures.—Measure off a certain quantity of the liquid, and take the specific gravity and the temperature. Then evaporate half away in the air or in a water bath. Now add water to make up the original quantity, and then take the sp. gr. at the same temperature as before. Subtract the one sp. gr. from the other, and the difference gives the specific gravity of the alcohol and water as they exist together in the wine or mixture. For example—

The sp. gr. of a wine at 50° F. . . .	= 0·9953
After evaporation, and made up with water, it	= 1·0080
The sp. gr. of the alcohol and water .	= ·9873

Spirit having the sp. gr. ·9873 at 50° F. expresses 9½ per cent. of absolute alcohol at 59·5° F., which is, therefore, the alcoholic contents of the wine.—*Mulder's Chemistry of Wine.*

MISCELLANEOUS.

American Platinum.—A new vein of platinum and gold has lately been found at Frederickstown, Mo., by Dr. Koch, of St. Louis. It is stated to be very rich.

Burnishing Paper.—The usual method of glazing paper is by rolling pressure, the webs of paper being calendered between metal and paper rollers. A new method for polishing paper has been introduced by J. Evans, of Hertford, which consists in bringing the paper into contact with sets of polished rollers driven far more rapidly than the surface of the paper. The web of paper is supported during the time it is passing through the calendering rollers by hard polished rollers instead of resting, as heretofore, upon rollers of wood and paper. This appears to be an extension of the calico-printers' and bleachers' method of calendering cloth for the purpose of glazing it.—*Scientific American.*

ANSWERS TO CORRESPONDENTS.

H. L. M.—Charcoal plates for galvanic batteries are made by combining hard charcoal dust (obtained from gas-retorts) with flour paste, then allowing them to dry, and submitting them to a red heat in a closed vessel. Nitric acid is generally employed for them, the same as in Groves, battery. We prefer platinum to charcoal plates.

S. S. Stevens.—A quick-drying varnish for paper or linen can be prepared as follows:—Take gum sandarach, 8 oz.; Canada balsam, 4 oz.; and dissolve them in a quart of alcohol. Varnish made with gum resins and turpentine do not dry so fast as those made with alcohol, but they are not so liable to crack.

Quærere Verum.—1. We do not know one. 2. We should think not. 3. Old name for chlorine. 4. At most instrument makers.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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THE BATH-BUN POISONING CASE.

In another column will be found the details of a case of wholesale poisoning, which, coming so soon after the similar occurrence at Bradford, and combined with the prevalent belief with respect to the poisonous adulteration of articles of food, is not unlikely to lead to some rather stringent legislation during the next session of parliament. It fortunately happens that, although several persons were poisoned at Clifton, and suffered dreadfully in consequence, no death has as yet occurred, and if none should take place it may happen that the author of their sufferings may escape unpunished, except from the loss of custom; it is therefore abundantly evident that some enactment should be made to enable the law to reach and inflict an adequate penalty on such offenders as these Clifton tradesmen. The case is certainly the very worst of the kind that ever came to our knowledge. In the Bradford affair there were circumstances which could be urged in extenuation; and the stuff sold for adulteration was, at all events, not poisonous, and unless taken in a large quantity possibly not even injurious; but when a druggist deliberately sells a poison which he must have known was to be used in giving a colour to an article of food, it seems to us that if a person dies from eating it his offence falls very little short of murder in a legal point of view, and is an infinitely worse crime in a moral point of view than merely killing a single individual. It has been suggested that this Clifton druggist was not a *chemist*, but it cannot be supposed that the most ignorant vendor of drugs does not know which of those he sells are poisonous, and in this particular instance there is not the shadow of an excuse of this kind, inasmuch as every preparation containing lead is known to be poisonous, and he must therefore have been aware when he was selling what he supposed to be chromate of lead that he was deliberately selling a substance which must inevitably injure the health even if it did not destroy the lives of several of his fellow creatures, for the sake of the paltry gain of a few pence. It is true that no case is recorded of death having been caused by this particular preparation of lead, but the subject of lead-poisoning has been so recently discussed in all its bearings that it is impossible to allow for an instant that any person who is sufficiently educated to be able to read a newspaper can be unaware that it, in common with all other allied substances, is a poison, and one of the worst kind of poisons too, viz. a slow and lingering one, which, taken into the system, produces effects which may be attributed to natural causes.

We believe that among the vast body of chemists and druggists in the kingdom, it would be difficult to find another beside this Clifton druggist who would wilfully sell poison for the purpose of adulterating food; but we are afraid that it would not be so difficult to find among them men who are not sufficiently careful in selling druggs of this kind; and we would gladly, in the interest of the general body of the chemists, see something done which would insure the observance of greater care. The measures which have been suggested do not appear to us calculated to effect the object proposed; and it would be difficult to point out any that would, without inflicting injustice on some who are entitled to consideration. Making it compulsory on every person who vends drugs to pass an examination at the Pharmaceutical Society as a condition of being permitted to continue his business, might be unjust to many respectable men who have been in the profession for years, and who, though having a good general knowledge of the qualities of the substances they sell, might still be unable to pass through the ordeal of an examination so strict as that of the Society above-mentioned; but it could not be an injustice to a person not yet in business to insist that before he should be allowed to engage in the sale of drugs and chemicals, he should possess a license, in the form of a certificate, showing that he had undergone the test necessary to prove him to be a competent person; and we are strongly of opinion that in future no man ought to be allowed to become a member of the important profession of chemists and druggists without possessing a certificate of this kind from the Pharmaceutical Society. Not only would there be no injustice to individuals in the passing of a bill enforcing this by the Legislature, but the public is fairly entitled to some such precautionary measure being taken; and which, moreover, could not be objectionable to the many highly educated men whose names are to be found enrolled in the list of members of the Society.

We confess we participate to a certain extent in the public alarm, and we cannot deny that there is some truth in the common supposition that the number of cases of poisoning from mistakes on the part of druggists which are discovered, are no criterion of the number of mistakes made. Anybody who is familiar with the poorest parts of London — and no doubt in other great cities it is the same—must have noticed the many dirty, wretched-looking shops, kept by persons who, on the strength of possessing a globular bottle of blue liquid, a poor man's plaster, and a little heap of sarsaparilla or Iceland moss in the window, and a few drugs in the drawers, claim to be considered as chemists and druggists; and not only lay claim to the title themselves, but are actually considered such by the poor creatures who live in their neighbourhood, and who are too ignorant to doubt their medical knowledge. The keepers of such shops as these are not only an injury to the respectable chemists and druggists, on whose education a large sum has been spent in properly qualifying them for the important position they occupy, but they are an imposition on the public. To close these shops by a legal enactment would appear a rather harsh measure towards the proprietors; but short of this we do not see what can be done to protect the public against the repetition of similar cases to that which has called forth these remarks. At all events, we will repeat that no one ought in future to be allowed to practise as a chemist and druggist without having previously passed an examination of the Pharmaceutical Society.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on the Existence of Hypobromous Acid, by JOHN SPILLER, *F.C.S., of the War Department, Woolwich.*

IN the course of an experimental determination of the actions respectively exerted by the elements, chlorine, bromine, and iodine upon the nitrate of silver, some few facts presented themselves which appear likely to be useful in more fully substantiating the existence of hypobromous acid.

Firstly, with regard to chlorine. If this gas be slowly passed through a cold solution of nitrate of silver, or freshly prepared chlorine water be brought into contact with the same, this latter being employed in excess, chloride of silver will be precipitated, and at the same time the solution will become strongly acid, and possessed of powerful bleaching properties, due to the oxidation of a second atom of chlorine which remains dissolved in the silver solution as hypochlorous acid. $Cl_2+AgO.\ NO_5=AgCl+ClO+NO_5$. This reaction, originally pointed out by Balard, I have verified more recently by weighing the amount of chloride of silver directly precipitated in that form, and also that subsequently obtained on decomposing the hypochlorous acid in the filtrate with excess of ammonia at a nearly boiling temperature; precipitating then a second portion of chloride of silver by the addition of nitric acid. These two amounts agreed so nearly as to leave no doubt of the truth of the reaction already set forth.

In performing the parallel experiment of adding bromine water to an excess of nitrate of silver solution similar appearances presented themselves. Pale yellow bromide of silver was precipitated, while a considerable amount of a bromine compound remained dissolved in the liquid, communicating to it bleaching properties, and exhaling an odour very similar to that of hypochlorous acid. Quantitative analysis demonstrated that, in this instance also, half the amount of bromine added passed directly into combination with silver, the other half remaining in solution, and existing doubtless in the form of an oxide analogous in constitution to that of the protoxide of chlorine, and to which the name of hypobromous acid (BrO) is applicable.

With iodine, under similar circumstances, a very different reaction is observed. In this case iodide of silver is formed, but unaccompanied by the simultaneous production of a bleaching compound; oxygen is set free, and apparently does not exhibit any tendency to pass on to the state of iodic acid (IO_5), the lowest oxide of iodine of which the existence has been fully established.

The Action of Ozone on some Organic Matters, by M. BESANEZ.

M. BESANEZ has found that on the following substances ozone has no action: urea, hippuric acid, allantoin, alloxan, creatine, leucine, fibrine, gelatine, starch, sugar, inosite, amygdaline, and salicine.

Cyanide of potassium rapidly absorbs ozone, and is changed into the cyanate. Uric acid diluted with water, and agitated with ozonised air, is dissolved and changed into allantoin and urea.

Creatinine is moderately acted on, the products being creatine, and an acid, the nature of which the author will describe hereafter.

The action of ozone on albumen is very curious. M. Besanez hoped to find urea among the protein bodies; but although he directed his attention particularly to this point he was disappointed. Not an atom of the compound was produced, and the author does not believe in the transformation of albumen into urea by oxidation with hypermanganate of potash.

In contact with ozonised air, albumen becomes slightly coloured, and then forms a coagulum somewhat analogous to fibrine, but insoluble in a solution of nitrate of potash. After some time this coagulum liquefies, and when the liquid ceases to absorb ozone, it is no longer coagulated by heat nor precipitated by mineral salts, always excepting the tribasic acetate of lead. By evaporation in a water bath it leaves a brownish residue, which is partially soluble in alcohol. The principal result of this experiment, according to M. Besanez, consists in the formation of a compound similar to that produced when albumen is acted on by gastric juice.

The action of ozonised air on casein resembles the action on albumen. When milk is operated on, the casein is first modified, the fatty matters resist longer, and the lactine is not all affected.

Amylic alcohol acted on by ozone gives first valerol and then valerianic acid.

Oil of cinnamon condenses a large proportion of ozone without being oxidised, but yields it up to substances more easily affected. In this way ozonised oil of cinnamon rapidly decolorises solutions of indigo.

Purified bile is not acted on by ozone: but fresh bile is quickly decolorised, the action being limited to the destruction of the colouring matter, and perhaps also the mucus.

Among the organic substances most eager for ozone is tannic acid. The author has not studied this re-action deeply; but he is certain that oxalic acid is formed, and a body which quickly reduces the cupro-ammoniacal liquid.

M. Besanez, as regards ozone, confirms a fact remarked by M. Chevreul, viz. that the presence of an alkali singularly hastens the oxydation of organic matters. The author also quotes an observation by M. His, who remarked that blood is so completely burnt by ozone that the residue is composed of scarcely anything but mineral substances. M. Erdmann has observed that ozone transforms indigo into isatine.—*Répertoire de Pharmacie.*

TECHNICAL CHEMISTRY.

Utilisation of London Sewage.

THE value of London sewage has been estimated at 3,796*l.* a day, or 1,385,540*l.* a year. Not one farthing of this enormous sum is at the present time realised. On the contrary, we are spending 3 millions of pounds to make the waste more complete and irrecoverable. At the same time we are sending thousands of miles to bring, at great expense, the very materials we waste so recklessly at home. But in a few years the guano deposits will be exhausted; and the supply may any day be seriously interfered with from other causes than the exhaustion of the deposits. It is right then, and indeed imperative, that we should look at home for something to replace guano, and criminal that we should waste the most prolific source of a substitute—the sewage of the metropolis.

The chemical difficulties in the way of extracting the

valuable constituents of sewage are no doubt great. They have been pronounced insurmountable. But a chemist is too apt to assume that what he has not succeeded in doing himself, and cannot at the moment see the way to effect is an impossibility; and he seldom hesitates to say so. In this way Messrs. Hoffman and Witt, a few years ago, discouraged all attempts to extract the valuable matters in sewage by chemical means. It is no wonder then that the Board of Works, which spends without hesitation thousands of pounds on the preparation of plans and specifications, should vote with reluctance a niggardly sum for occasional chemical assistance. This is perfectly intelligible. Miles of tunnelling and mountains of bricks and mortar are easily appreciated by the public who can see no benefit in what would appear to result in no immediate good. The very idea of an experiment is repulsive to them. It suggests an uncertain issue, and all they can see is a certain outlay. It is for these reasons, we suppose, that a Board which employs a staff of engineers to consummate the waste of our sewage has never regularly engaged a chemist to try if the valuable matters in it could not be saved.

Now and then, when a great outcry has been made about some local nuisance, a small sum has been voted, and some gentlemen have been employed whose time was already too much occupied to allow them to do much more than make a report. But the great question is still left in abeyance. It cannot, however, long remain so. Schemes are constantly invented, some apparently feasible, others chimerical and preposterous; and the Board ought at once employ a competent chemist and give him liberal means for testing the value of any reasonable plan which may be proposed. We publish the specification of one to-day, which certainly deserves more attention than it has yet received. It does not completely solve the problem, for it only extracts a portion of the valuable constituents. But so far it is decidedly the best which has been proposed; and actual experiment, on a small scale, has shown that it may be applied to London sewage, with a large daily profit.

Baron Liebig on the Sewage Manure Question.

A LETTER from Baron Liebig to Mr. Mechi, on the subject of sewage manure, has been published in the *Times*. Mr. Mechi, in a letter to the *Times*, a short time ago, insisted on the great importance of the subject to England, and the Baron takes up the matter in support of Mr. Mechi's views:—"It is my ardent wish," he says, "that you may succeed in awakening the English people to your own convictions; for in that case the ways and means for setting aside the difficulties which stand in the way of procuring manure from the sewage of towns, will certainly be found, and a future generation will look upon those men who devoted their energies to the attainment of this end as the greatest benefactors of their country."

The Baron goes on to remark on the constant diminution of productiveness in a soil, occasioned by the loss of those elements which are indispensable to the reproduction of the crops:—"The loss of these elements is brought about by the sewerage system of towns. Of all the elements of the field, which in their products in the shape of corn and meat, are carried into the cities and there consumed, nothing, or as good as nothing, returns to the field. It is clear that if these elements were collected without loss, and every year restored to the fields, these would then retain the power to furnish every year to the cities the same quantity of corn and meat; and it is equally clear that if the fields do not receive back these elements, agriculture must gradually cease."

He then combats the opinion that England will always be able to exchange her coal and iron for corn:—"The time may perhaps come, even in half a century, that not one of those countries upon whose excess England has hitherto drawn will be able to supply her with corn; and that too from the natural law, that what is true of the smallest piece of ground is true also of a great country. It ceases to produce corn, if the conditions of the reproduction of the corn which has been carried off are not restored to it. Nor is it, furthermore, certain whether the corn-growing countries will always desire to exchange their corn for the products of English industry, since they may no longer need these products, or at least in the ratio of England's need of corn. History teaches that not one of all those countries which have produced corn for other lands have remained corn markets; and England has contributed her full share towards rendering unproductive the best lands of the United States, precisely as old Rome robbed Sardinia, Sicily, and the rich lands of the African coast of their fertility. Finally, it is impossible in civilised countries to raise the corn production beyond a certain limit, and this limit has become so narrow that our fields are no longer capable of a higher yield, without an increase of their effective elements by the introduction of manures from abroad."

The Baron then goes on to notice the well-known effects of bones and guano, and after remarking that the high price of bones already forbids their export from Germany, he continues:—

"In relation to guano I have been assured that in 20 to 25 years, if the use of guano should increase in even the same proportion as hitherto, there will not remain in South America enough to freight a ship. We will, however, suppose its supply and that of bones to continue for 50 years, or even longer; then what will be the condition of England when the supply of guano and bones is exhausted?

"This is one of the easiest of all questions to answer. If the common sewerage system is retained, then the imported manures, guano and bones, make their way into the sewers of the cities, which like a bottomless pit have for centuries swallowed up the guano elements of the English fields, and after a series of years the land will find itself precisely in the condition it was before the importation of guano and bones commenced; and after England shall have robbed the cultivated lands of Europe, even to complete exhaustion, and taken from them the power to furnish her longer with corn and manure, then she will not be richer than before in the means of producing corn and meat, but will from that time forth become even poorer in these means.

"It has been maintained that the recovering of the manure elements out of the sewers of large cities is impracticable. I am not ignorant of the difficulties which stand in its way. They are, indeed, very great; but if the engineers would come to an understanding with the men of science in relation to the two purposes—the removal of the contents of the sewers, and the recovery of their valuable elements for agriculture—I do not doubt that a good result would follow. Intelligence, in union with capital, represents a power in England which has rendered possible and practicable things of much greater apparent difficulty."

The letter concludes with a warning:—"I know that the prophets of future evil have at all times been derided by their own generation; but if history and natural laws can furnish any ground for a just conclusion,

then there is none which stands more firmly than this—that if the British people do not take pains to secure the natural conditions of the permanent fertility of their land—if they allow these conditions as hitherto to be squandered—their fields and meadows will, at no distant time, cease to yield their returns of corn and meat."

Description of a Patent Blast Gas Furnace, by J. J. Griffin, *F.C.S.*

[*Continued from page 29.*]

Gas Furnace heated at the Bottom.—In this furnace the parts are the same as those marked *a*, *b*, *c*, *d*, *e e*, in fig. 2; but the gas-burner is in this case put into the bottom of the furnace, instead of the top, and the arrangement of the crucible and its support is altered. Upon the centre of the clay plate *d*, the perforated plumbago cylinder and cover Nos. 5 and 7 are placed; and upon them a plumbago crucible, No. 10. The size of the crucible, and the height of the perforated cylinder, are to be so adjusted that the bottom of the crucible shall be struck by the hottest part of the gas flame; that is to say, the space left between the face of the gas-burner and the bottom of the crucible must not exceed 2½ inches. The crucible is provided with a closely-fitting cover, and pebbles are then filled in between the crucible jacket and the furnace cylinder, and are covered over the crucible until both the pieces of the furnace *e*, *e*, are filled. The gas is then lighted, the blast of air is set on, the gas-burner is forced up into the hole in the clay plate *d*, and the operation proceeds. In from ten to twenty minutes after the gas is lighted—this difference of time depending upon the size of the furnace and the weight of metal contained in the crucible—the interior of the lower cylinder *e*, acquires a white heat. The progress of the operation can be watched by occasionally removing the stone peg in the trial-hole of the furnace cylinder *e*. The heat very slowly ascends into the upper cylinder, and it never becomes so great in the upper as in the lower cylinder. The greatest fusing power of the furnace is confined within a vertical space of about six inches, reckoning from the bottom. The power of flint pebbles to abstract heat from the gases which pass through this apparatus is quite remarkable. When about six inches of pebbles lie above the crucible, and the crucible and the pebbles about it have been white-hot for half an hour, the hand can be held over the top of the furnace, within a few inches of the pebbles, without inconvenience. It becomes wetted with the vapour which rises from the furnace, but feels only a moderate degree of heat.

This form of the furnace is attended by the inconvenience that you cannot examine the condition of the matter contained in the crucible, to ascertain when the heat has been continued long enough. In cases where the fusion is performed repeatedly on the same weight of metal, this would be of no importance, because the power of the furnace is so steady and regular, that the time of firing which has been found to answer once will answer the same purpose again.

When it is supposed that the fusion of the metal submitted to trial is completed, the gas is first to be turned off, and then the supply of air stopped. You can either allow the furnace to remain intact till it is cold, or lift off the cylinders *e*, *e*, with tongs, and allow the hot stones to fall into the iron pan placed below the furnace to receive them. A few bricks should be laid between the pan and the table or stool on which it rests, if the latter is made of wood; because the heat given off by the pebbles is very great. The pebbles being raked away from the crucible, the contents of the latter can be examined.

The absolute sizes of the furnaces depend upon the amount of work required from them. The fusions described below were mostly made in a furnace of six inches internal diameter, a few in a furnace of four inches internal diameter, and one or two in a furnace of eight inches internal diameter; all of them with a gas-burner of sixteen holes, and a supply of gas obtained from a half-inch pipe. A large furnace with an internal diameter of twelve inches, will demand a gas-burner of twenty-six holes, and a supply of gas from a pipe of nearly one inch in the bore.

Examples of Fusions effected by the Blast Gas Furnace.—The fusing points of certain metals have been fixed by Daniell at the following temperatures:—

Silver	1873° F.	Copper	1996° F.
Gold	2016°	Cast-iron	2786°

Brass, with 25 per cent. of zinc, at 1750° F.

All these metals melt readily in the gas furnace. Quantities of 3 lb. of copper or cast-iron can be completely fused in fifteen minutes in a six inch furnace. Quantities of 8 or 10 lb. of copper or cast-iron can be completely fused into a homogenous mass in a six-inch or eight-inch furnace within one hour, using a sixteen-hole burner, and a supply of gas from a half-inch pipe.

In a furnace of the same size I have fused 45 ounces of nickel, and in other experiments I have produced masses of wrought-iron weighing 18 ounces, 28 ounces, and 40 ounces. The piece of 18 ounces was perfectly fused. The piece of 30 ounces was not quite fused, the crucible having melted, and stopped the operation. I have also fused cobalt, and reduced it to the metallic state from the peroxide by ignition with charcoal. The time required for the fusion of these refractory metals is from one and a half to two hours.

Scraps of platinum can be fused into a porous mass, but not into a solid homogenous bead. I have mentioned that thin platinum wires fuse readily in the free flame of the gas-jet produced by the burner fig. 1; but when the jet plays upon a quantity of the metal contained in a crucible the relations of power and effect are different.

When the metals to be melted are such as do not undergo oxidation, the method of action represented by fig. 2 is most convenient. In this manner gold can be readily melted, and by removing the gas-burner the melted metal can be stirred. When the action of oxygen is to be avoided, the crucible must have a cover, which in some cases should be securely luted to it.

Choice of Crucibles.—The experiments above referred to were made with coal gas at the ordinary pressure, and with a blast of cold atmospheric air. Greater effects can be produced by the use of oxygen gas, or of heated atmospheric air. But a difficulty stands in the way of the use of these greater degrees of heat in the want of crucibles capable of enduring their action.

With cold atmospheric air, pure nickel and pure iron dissolve every kind of siliceous crucible, and it is therefore needless to heat the air or to prepare oxygen till a superior kind of crucible is obtainable. At present, these metals can only be melted in plumbago crucibles, which necessarily communicate to them more or less carbon.

Metals which melt at moderate degrees of heat, such as gold and copper, are easily fused either in clay crucibles, or in those of plumbago; the latter, be it remem-

bered, being a mixture of graphite and clay. Metals in combination with carbon, such as cast-iron, also melt readily in clay crucibles, without destroying them. But when such metals as iron, nickel, and cobalt, are freed from carbon, and brought into a state of purity, they acquire an extraordinary attraction for silica at a white heat, so that the metal and the silica readily run down into a very fusible silicate. Even when plumbago crucibles are used, the carbon burns away at some particular point, the metal then attacks the clay, bores a hole through the crucible, and finishes the operation. No kind of clay or porcelain will withstand the action of pure iron or nickel at a white heat. It is therefore impossible to effect any large fusions of these metals when they are free from carbon, or when they are heated in crucibles that are free from carbon.

Fusion of Metals in large quantities and Ignition of Objects of large size.—As the gas-burner, fig. 1, can be held in any required position, it is possible to apply heat to large objects by using several gas-burners. Thus, a large crucible may be fixed in a square furnace, and gas-burners be applied below and on the four sides of the furnace; the spaces between the crucible and the walls of the furnace being filled with pebbles, to collect the heat and apply it to all parts of the crucible.

Muffle Furnace for Assaying, Roasting, &c.—A muffle, placed in an assay furnace, and built up with pebbles, can be heated either from above or from below by the blast gas-burner. The flame and products of combustion can be made to sweep through the muffle, whether going upwards or downwards. The *air* pipe and *gas* pipe attached to the gas-burner, fig 1, must each be provided with a stopcock. When the front door of the muffle is opened to afford the opportunity for examining the cupels, the blast, if continued, would blow out there against the operator; but that occurrence is prevented by turning the stopcocks. When it is desired to oxidise the substances in the muffle, the furnace is first brought up to a sufficient temperature, and then the gas is turned off, but the blast of air is continued. The air passing through the hot pebbles enters the muffle at a high temperature, and then the gas is turned off, but the blast of air is continued. The air passing through the hot pebbles enters the muffle at a high temperature, and not exhausted of oxygen, because there is no carbonaceous matter present among the pebbles when the gas is turned off. The pure and highly heated air is consequently in a proper condition for oxidising metals that are already raised to a red heat in the muffle. The same apparatus is useful where substances require to be roasted in the presence of air, in order to oxidise and expel some volatile ingredient. We have in this process an effectual means of using hot air to aid the process of cupellation.

Distillation per descensum.—Suppose a stoneware bottle with a long neck to be fitted with a stoneware tube, passing nearly to the bottom of the bottle, and projecting some inches beyond its mouth. Suppose this bottle to be half filled with metallic zinc, and then to be fixed upside down in the furnace, fig. 2, with the tube projecting downwards through the hole in the plate *d*, and nearly dipping into a vessel of water. The furnace being packed with pebbles, and the heat applied at the top, the distillation of zinc *per descensum* then takes place.

Miscellaneous Uses of the Blast Gas Furnace.—1. The preparation of chemical substances by the projection of mixtures into a crucible kept at a red or a white heat. 2. For melting silver, gold, copper, cast-iron, brass, bronze, nickel-silver, &c., either for making small castings or ingots. 3. For experiments on glass; every description of which it is able to fuse. 4. For experiments on enamels, coloured glasses, and artificial gems. 5. For experiments on metallic alloys. 6. For the fusion of steel. 7. For the use of dentists, in the preparation of mineral artificial teeth. 8. For the assay of ores of silver, copper, lead, tin, iron, and other metals. 9. For all purposes of ignition, combustion, fusion, or dry distillation, at a red heat, or a white heat, where it is desirable to produce those temperatures promptly, certainly, steadily, conveniently, and cheaply.

Exhibition of Coloured Flames.—When the gas-burner, fig. 1, is supplied with gas and air, and is inflamed in the open air, so as to produce a clear blue flame of 3 inches long, and beyond it a flickering, nearly colourless flame of 12 inches long, brilliant colours may be given to this flame by the introduction of concentrated solutions of certain salts. A ball of pumice-stone, 2 inches in diameter, fastened to a stout iron wire, is dipped into the saline solution, and while wet is plunged into the flame, upon which the whole flame becomes coloured. Solutions of the following salts may be used for these experiments:—

1. *Chloride of Strontium*, gives a brilliant crimson flame. 2. *Chloride of Calcium*, a reddish-orange flame. 3. *Chloride of Sodium*, brilliant yellow. 4. *Chloride of Copper*, bluish-green. If the flame is touched on one side with the copper solution, and on the other with the strontium solution, half the flame is green and half crimson. The colours and reflections of these flames are necessarily most brilliant in a dark room. A remarkable effect is produced by the yellow soda flame. It is reflected from the human countenance with a ghastly blackness.

Repair of the Gas Furnace.—When the clay cylinders become warped or chipped, so as to allow the gases to escape at the joints laterally, they must be luted for each operation by applying a little wet fire-clay by means of a spatula. When only a moderate heat is required, this luting is unnecessary.

The Patent Blast Gas Furnace is capable of melting so many of the refractory metals, and in quantities that are so well adapted for the usual analytical experiments of chemists and assayers, as almost to supersede the use of fixed wind furnaces and portable blast furnaces, fed by charcoal or coke.

On Starches, the purposes to which they are applied, and Improvements in their Manufacture.

Mr. F. Crace Calvert, F.R.S., read a paper on the above subject at the Society of Arts, on Wednesday, December 1st. At the beginning of this century, he said, starch was only used in the laundry, for the toilet, and to a limited extent as diet; but since it and its products have become used in manufactures its consumption has so enormously increased that at one single print works near Manchester more than 300 tons are used annually. In nature starch is often found associated with poisonous matters—in the arum with an acrid substance—and in the mannihot with prussic acid; but the natives of Guiana and the West Indies have found out that by heating the roots of the mannihot the prussic acid is dissipated, and then the tapioca obtained is harmless.

Although the globules of different starches vary in size, and the envelope has a different molecular arrangement to the internal part, still analysis has proved that all have the same chemical composition: viz. C_{12} H_9 O_9 or 72 parts of carbon and 81 of water. With the exception of inuline, all starches give a blue colour with iodine, which disappears when the solution is heated, but returns when it cools. M. Payen has found that by leaving starch in contact with ammonio-oxide of copper for several hours, and then washing the excess of the latter away, and afterwards boiling the green precipitate, a splendid purple will be formed on the addition of iodine, which is comparatively permanent. The globules of starch are found to be composed of successive concentric layers; and M. Payen has observed that these layers have different degrees of solubility in the ammonio-oxide of copper. The outer envelope he found to swell out to 1000 times its original size when in contact with the solution. As extracted from the potato, starch contains 45 per cent. of water, and when stored in a dry place will retain 18 per cent. To distinguish between a starch with little and one with much water it should be placed on a metallic plate heated to 212°, when the former will fly about and the latter agglomerate into hard lumps. Advantage of the last fact is taken on the Continent to manufacture large quantities of artificial tapioca from potato starch.

Starch is converted into sugar by many well known processes, and M. Niepce St. Victor has recently made the curious observation that when paper impregnated with starch is exposed to sunlight the starch is slowly converted into sugar. Starch is also converted into an isomeric substance named glycogene, by the action of the saliva and pancreatic juice. Like flax and cotton, when treated with concentrated nitric acid, it is changed into a fulminating substance called xyloidine.

The starches principally used in commerce are arrowroot, sago, rice starch, wheaten starch, and fecula or potato starch. Arrowroot is only used for food. Sago is extensively used as a substitute for potato starch, either for sizing of warps, or for adulterating other farinaceous substances. Rice starch is obtained by acting on ground rice by alkalies or their carbonates, which dissolves the nitrogenous matter, and liberates the starch. Wheaten starch is found associated with gluten, which was formerly a waste product in the manufacture, but which has recently received a valuble application in calico printing. Mr. Walter Crum has found that under certain circumstances gluten is soluble in weak alkalies, and thus he has used it instead of albumen for fixing on muslins the beautiful colour called French purple.

Starch is usually made by mixing wheaten flour with water in large vats, and allowing it to ferment for several weeks. The fermentation produces what is called *sour water*, which contains alcohol, acetate of ammonia, acetic and lactic acids, biphosphate of lime and decomposed gluten. Alcohol is first formed, but it is rapidly transformed into acetic acid, and it is by this acid and the lactic acid that the separation of the starch and the gluten is effected. The fermentation and the acids, however, do not remove or destroy the whole of the gluten, which forms a layer called alimes or flummery on the top of the starch. This, which was formerly used for feeding pigs, is now employed by the calico printer as a resist paste. After the alimes have been removed by washing and by sieves, the starch is allowed to settle in clear water for several days. It is then drained from the water, dried and cut into lumps of about six inches cubic, which are placed in carefully heated stoves, where they split into the irregular pieces well-known to consumers. Potato starch cannot assume this peculiar form. The foregoing process has been improved upon by Mr. Martin, who kneads the flour into dough, and then washes out the starch, leaving the gluten behind. By this means a larger yield of starch is obtained than by the old process. The gluten is now sold in London under the name of semolina. By adding gluten to flour he also makes maccaroni and other pastes of the same sort. Wheaten starch is extensively used by calico printers for thickening colours in which free acids are employed.

Potato starch is principally made on the Continent by mashing the potatoes, and then elutriating the pulp upon a fine wire sieve, which separates the starch from the fibre. The starch is drained in boxes lined with felt, and then dried on floors of plaster of Paris. To remove the disagreeable taste starch so prepared has, Mr. Martin washes it with a weak solution of carbonate of soda. In addition to the applications before-mentioned, potato starch is extensively used in print works for thickening colours and finishing goods. The Glenfield Company, by mixing a trace of sulphuric acid with the starch, produce an article which forms a clear fluid when boiled with water, in consequence of the conversion of the starch into dextrine. Oxalic acid will effect the same change. Mr. Sorel has shown that a new plastic material capable of replacing, in some instances, ivory and horn, may be made by mixing flour with a solution of chloride of zinc.

When farina is heated to a temperature of 250° to 300° for several hours, it takes the colour of amber, and becomes soluble in water. In this state it is largely used by calico printers. The change which takes place in the heating is only a *molecular* one. M. Payen has shown that the same change may be produced at a lower temperature, by mixing 400 parts of dry farina with 1 part strong nitric acid diluted with enough water to make the farina into a hard paste, which is then dried and heated for 20 hours to 200° F. The product is a farina very nearly white. Mr. O'Neil effects the same result by submitting starch, or any amylaceous substances, to the action of muriatic acid gas or other acid vapours in a cylinder surrounded by steam.

By using a larger quantity of acid, a *chemical* change is produced in the starch, and grape sugar is obtained. This was largely used on the Continent in the preparation of beer. It is prepared by adding farina to sulphuric acid diluted with 33 parts of water, and boiling for 30 or 40 minutes. The sulphuric acid is then removed by means of chalk, and the saccharine solution is evaporated. If the boiling is stopped as soon as the solution gives a purple colour with iodine, *dextrine* is obtained. The same changes are effected by *diastase*, but at a much lower temperature; and it is practically of great importance to know that the action of this body is completely destroyed by raising the temperature to 200° or 212°.

PHARMACY, TOXICOLOGY, &c.

On the Preparation and Properties of Podophyllin.

PODOPHYLLIN is prepared from the root of mandrake (*podophyllum peltatum*), indigenous to various parts of the United States.

It has been stated by some writers that podophyllin contains three principles, viz. resinoid, neutral, and alkaloid. This was a mistake. Pure *podophyllin* is a pure resinoid, composed of two resins, and no neutral or alkaloid principle. In another place we shall refer to these

principles, and demonstrate that such podophyllin is an hydro-alcoholic extract.

Properties of Pure Podophyllin.—Its colour varies according to the mode of preparation, varying from a dark brown to a lemon yellow. It is insoluble in acids; precipitated from its solutions by them; soluble in alkaline solutions; insoluble in cold or hot water, either pure or acidulated; dissolves entirely by alcohol. When its alcoholic solution is evaporated to a syrupy consistence, and mixed with water, all the podophyllin is precipitated, and the filtered liquor is colourless. A portion only is soluble in ether; the insoluble portion is soluble in alcohol. Experiments with the root collected in the spring and autumn give the following results:—

	Podophyllin from the spring root.	Podophyllin from the autumn root.
Resin, soluble in ether	54·34	39·95
Resin, soluble in alcohol	45·66	60·05
Total	100·00	100·00

Properties of the alcoholic extract of Mandrake.—The colour is dark brown; exposed to the air it absorbs water, and becomes soft; is soluble in alkalies: partially so in acids. Water dissolves a very bitter principle, which is probably the so-called alkaloid, and neutral alcohol dissolves it entirely. When the solution is evaporated to a syrupy consistence, and added to water, a portion only is precipitated, and the filtered liquor is highly coloured. Ether dissolves but a small portion, being that portion of the resin soluble in it.

Experiments were made with the mandrake root collected in the spring and autumn, with the following result:—

	Extract from the spring root.	Extract from the autumn root.
Soluble in water	68·65	41·64
Soluble in alcohol	31.35	58·36
Total	100·00	100·00

The portion soluble in water is the bitter principle; that soluble in alcohol are the resins.

Properties of the hydro-alcoholic extract.—The hydro-alcoholic extract has a colour somewhat darker than the alcoholic extract. It attracts moisture more rapidly from the atmosphere than the alcoholic extract; partly soluble in acids; soluble in alkalies; partly soluble in alcohol and ether. When the alcoholic solution is evaporated to a syrupy consistence, and mixed with water, some podophyllin is precipitated.

The hydro-alcoholic extract yields:—

Soluble in water	67·05
Soluble in alcohol	32·95
Total	100·00

Properties of the aqueous extract.—Much darker colour than the last; cannot be reduced to a powder without the addition of some foreign substance; attracts rapidly the moisture of the atmosphere; soluble in acids and alkalies; a portion is soluble in alcohol, but the alcoholic solution does not precipitate any resin; insoluble in ether.

It will be observed that it is not difficult to distinguish *podophyllin* from the extracts of mandrake, for when treated by pure alcohol—if the article is entirely dissolved—it is either *podophyllin* or an alcoholic extract. These are distinguished by the quantity of podophyllin precipitated by water from the alcoholic solution. If the article is not entirely dissolved in alcohol it is an hydro-alcoholic extract. These are distinguished by adding water to the alcoholic solution in the hydro-alcoholic extract that the *podophyllin* is precipitated. In the aqueous extract none will be found.

Pure Podophyllin mixed with Syrup of Milk, Salt, Magnesia, or Powdered Root.—Treat the mixture by strong alcohol till all the podophyllin is dissolved; the foreign substance remains insoluble; filter, wash well with alcohol, and dry. The weight gives the amount of adulteration. To determine the character of the adulteration, we refer to another part of our article.

Alcoholic extract mixed with same articles.—Treat the same as for pure podophyllin.

Hydro-alcoholic extract mixed with same articles.—If the substance is magnesia or carbonate of magnesia, treat the mixture with alcohol, proof or 56°; collect the insoluble residuum on a filter, wash it with alcohol, and dry. Its weight gives the magnesia or carbonate. If the substance is *sugar of milk*, treat the mixture by water, and filter; pass the aqueous solution through animal black, filter, and evaporate to dryness. The weight gives the quantity of sugar of milk. If salt, deodorise by animal charcoal; precipitate the chlorine by nitrate of silver, and use the formula given in the last article.

Aqueous extract mixed with same.—If sugar of milk or salt, proceed as above; if magnesia or powdered root, dissolve in water, filter, and wash residuum well. Its weight will give the quantity of mixture.—*American Journal of Materia Medica.*

Pharmacology of the Mistletoe.

THE *viscum album*, *viscum quercinum*, or mistletoe, belongs to those medicinal agents which probably possess a specific and valuable medical quality, but which, by degrees, have from various causes lost their reputation. According to Pliny, the Druids of Germany considered as holy every oak on which a mistletoe plant grew; and collected the latter with a peculiar ceremony. The plant was worn as an amulet against cramp and epilepsy, and many physicians from that date administered it internally, and spoke highly of its qualities. Colbach affirmed that mistletoe, when properly prepared, stored, and employed with due precaution, cured epilepsy no less certainly than cinchona did intermittent fever.

There can be no doubt that the true *viscum quercinum* of the ancients is the *loranthus Europæus*, a plant which grows upon oak and chestnut trees in southern Europe, and possesses much similarity with the *viscum album*. The latter, however, is smaller, and grows in western and northern Europe on old linden, beech, pear, apple, and hawthorn trees. It is more widely dispersed, and more prolific than the true *viscum quercinum*, but is less active, and therefore a really efficient and valuable medicinal agent fell into disrepute, and was at length forgotten.

It is probable that our *viscum album* possesses similar properties to the *quercinum*, but the truth of the conjecture has not been established by chemical and therapeutical observations. All that relates to the botany of species mentioned, as well as to the chemical characteristics of the *viscum album*, and especially the substance called *viscin*, has been investigated by Henry, Gaspard, Fauke, and others. The curative value of the juice of the berries of the *viscum quercinum* has been examined by Hardy. He mixed one part of the juice expressed from the berries with two parts of melted yellow wax, adding the wax by degrees until an ointment of the proper consistence was formed. This he applied to the

affected part, confining it with a bandage. The application was allowed to remain until the pain moderated, which was usually in the course of a few minutes. Should the pain continue, the plaster may remain a day or more. After its removal the part should be rubbed with oil of almonds. The plaster may be applied to the nape of the neck, in which case it may be allowed to remain longer.

The plaster occasions a violent itching, without reddening the skin or raising a blister. In many cases the patient experiences a slight confusion of intellect, and drowsiness without true sleep; sensation becomes obtuse, and the pain less intense. Fresh plaster need not be used on every occasion, the same being employed many consecutive times with the same effect: moreover, the plaster mass may be kept good for a considerable period if preserved in a well closed vessel.

Hardy has also dried and powdered the berries and used them with good effect with dry friction. He has proved that mistletoe applied in one form or the other always acts as a palliative in cases of pains in the head, spinal marrow, or abdomen.—*Buchner's Repertorium.*

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY, 2 Nov. 1859.[1]

T. N. R. Morson, Esq., *President, in the chair.*

A gold medal was presented to Mr. Henry Pratt, of Stratford-on-Avon, for the best collection of British plants. The herbarium was exhibited and fully justified the highest encomiums.

A paper by Mr. H. N. Draper, of Dublin, on "The analysis and preparation of *Granular Citrate of Magnesia*," was then read. The writer's curiosity had been excited by an article sold under the name of citrate of magnesia, which, being in the form of granules and effervescing when added to water, showed that an acid and a carbonate had been mixed together in some unusual way. A careful quantitative analysis showed that the granules were composed of bicarbonate of soda, sulphate of magnesia, and tartaric acid. No citric acid at all was found, and only one and a half per cent. of magnesia. The article was therefore a citrate of magnesia only in name. It had a "terebinthinate odour," for which the author had at first some trouble to account. On reflecting, however, that the mixture must have been made at a high temperature, he thought that some oil of lemon might have been added before the heat was applied,—a supposition which was confirmed when he came to make experiments in imitating the article. He gave the following formula for the preparation of a similar compound:

Bicarbonate of soda	12 oz.	0 dr.
Tartaric acid	10	0
Sulphate of magnesia . . .	2	3
Citric acid	0	5
Oil of lemon	5 drops.	

Rub the citric acid and the sulphate of magnesia to powder together, then add the tartaric acid and bicarbonate, and mix intimately by sifting. Have ready a capsule—preferably of polished copper—set in a water bath, and so arranged that the water vapour shall not come in contact with its contents, and when it has become heated, introduce the mixture into it. After the lapse of a few minutes, the mass will be observed to separate, and it should then be rapidly stirred with a glass or bone spatula until the granula are completely formed. It is then only necessary to keep them from adhering to the sides and bottom of the capsule during the time occupied in drying. Finally, the oil of lemon is added. The operation may be judged to be complete when the granula are perfectly white, and do not feel soft upon pressure under the spatula.

Mr. Haselden then read a paper on the "Miscibility of chloroform, and the so-called chloric ether, with water and other liquids."

The strength of the solution of chloroform in rectified spirit used under the name of chloric ether, is known to vary in different establishments. Mr. Haselden had seen one sample which had one part of chloroform in four of spirit, another was composed of one part of chloroform and nine of spirit; and he had received a specimen from Rome which had only one of chloroform in fifty of spirit. He had made a variety of experiments with the view of ascertaining to what extent chloroform by itself was miscible with water, to what extent spirit assisted, and whether any and what substances interfered with the miscibility, and also to see whether a mixture of chloroform and spirit distilled together was more miscible than a simple solution which had not been distilled. He found that ten minims of chloroform would perfectly dissolve in four ounces of water, if the mixture was well shaken for some time. Ten minims of chloroform with seventy minims of rectified spirit mixed with the same quantity of water without agitation, and the chloroform did not separate. He had kept such solutions a month without observing any separation. Neither dilute acids, tinctures, camphor, gum, nor any substance he tried which was likely to occur in a prescription at all affected the solution. Any stronger solution of chloroform and spirit than the above was found to separate when mixed with water in the same proportions. The distillation of the two bodies together was not found to make any difference in the miscibility. A solution of one part of chloroform in thirty-nine of rectified spirit mixed with water without separation, in any proportion. On the whole, Mr. Haselden believed that a mixture of one part of chloroform and nine parts of rectified spirit (by measure) would be found the most useful for medical purposes, and he hoped a solution of this strength would be introduced into the new Pharmacopœia under a more appropriate name than chloric ether; and he suggested that it should be called *Spirit of Chloroform*. Mr. Squire said that spirit of chloroform was the name that the Pharmacopœia committee had decided on.

A paper on the "Preparation of Pills" by Mr. Tichbourne, Dublin, was then read. The author said that few difficulties the dispenser had to encounter were more annoying than having to form into globular pills a dropsical mass which could never retain its shape a moment—or a hard lump which a pestle and mortar could only grind to powder. Pills composed of various extracts, powders, and volatile oils, were ordered to be made into a mass by means either of soap, conserve of roses, spirit of wine, castor oil, or treacle. To most of these excipients objections might be made. In some cases it was best to make the powders into a soft paste with water, and then to evaporate to a proper consistence, adding the volatile oil towards the end of the process. But what he had found most generally useful in forming pill masses, was a mixture of soap and treacle, made by dissolving hard soap, cut into shreds, in treacle by means of heat, and straining the mixture while hot through fine muslin. Glycerine may be used with advantage in some cases; but when resinous matters enter into the composition, the glycerine sometimes oozes from the mass in tears. This may be prevented by using equal parts of rectified spirit and distilled glycerine. Pil. Cambog. Co. and Pil. Ferri Co., which keep soft, may be made with this mixture. The Pil. Ferri Co., the author said, should be made with the Ferri sulphas exsiccatum; and he suggested that the sulphate was best dehydrated by boiling the powdered crystals in a flask with spirit of wine, keeping the mixture in a state of agitation for a time. The dehydration was completed after boiling 4 or 5 hours, when the spirit might be poured off and the sulphate removed. Pill masses, the author continued, were peculiarly liable to sophistication; and he believed that at least 60 per cent. of

[1] In order that the readers of the Chemical News may be placed in possession of a complete record of the meetings of this Society during the present session, we now give an abstract of the meeting which took place previous to the publication of our first number.—Ed.

those sold were spurious. The blame, he considered, rested partly with the scientific prescriber, who sometimes ordered expensive drugs with no particular therapeutical object (*e. g.* saffron in Pil. Aloes c Myrrhâ): but much more attached to the retail druggist and compounder, who, for the sake of a little extra profit, induced the manufacturer to furnish an article at a less cost than the genuine could be produced.

Mr. Squire said blame in the matter was out of the question. The remarks of the author probably applied to what was sold in Dublin. The meeting then adjourned.

NOTICES OF BOOKS, PATENTS, &c.

The Causation and Prevention of Disease, by John Parkin, *M.D.* Churchill: 1859.

Of the chemistry of morbific poisons in general, very little is known — of those concerned in the production of cholera and fever we know nothing at all. They have hitherto defied all the efforts of the chemist to isolate them. One day, no doubt, the analyist will seize on them, and exhibit their physical conditions, and explain all their chemical relations, but that day is probably far distant; and with our past experience, that poisons are discovered ages before antidotes are found, we can hardly wish a speedy success in wringing from Nature her fearful secret.

In the meantime if we know nothing of the poisons themselves, we do seem to know something of the conditions under which they are generated, and the circumstances which appear to promote their action. And yet so glaring are the contradictions obtained when these conditions and circumstances are investigated, that the seeker after truth without a theory to support, hesitates a long time before he draws any general conclusion, and perhaps altogether abandons the attempt to do so. We cannot wonder then that Dr. Parkin refuses his assent to the common opinion which refers the production of cholera and fever to the decomposition of animal and vegetable matter, to overcrowded dwellings and towns, or to the use of impure water. He reads that the Kamtschatkans live upon and among putrid matter for more than half the year, and that six families of them with all their provisions for the period, are crowded into one small underground cabin, and yet suffer from nothing but scurvy. He finds that in the knackers' yards at Montfaucon, where the flesh of the animals slaughtered is allowed to putrefy for manure, and where the stench is the most horrible that can be conceived, the men and women regularly employed say they are never ill, that they have all the appearance of perfect health, and are known to be long-lived. He is told that occasional workmen suffer no ill effects, nor does an infant "whose cradle during the hours of labour was the carcase of a horse." Decaying vegetable matters seem to be quite as innoxious. The suffocating stench in a ship freighted with sugar, was never known to generate disease, and the emanations from flax are quite harmless, when it is macerated in a house.

Nor are the *known* gaseous products of decomposition, taken separately, capable of producing cholera or fever. Carbonic acid, nitrogen, sulphuretted hydrogen, carburetted hydrogen, phosphuretted hydrogen and ammonia, will all kill when respired in sufficient quantity, but do not produce specific diseases. Sulphuretted hydrogen has been supposed to be the fever miasm, but if it really were so, what student of chemistry would escape the disease? But Dr. Parkin is quite in error when he says that we are well acquainted with all the products of the decomposition of organic matter. If he had ever attempted to analyse the gases evolved from decomposing sewage, or those obtained from Thames water by boiling, he would have found more than the gases he has enumerated above. There is, for instance, that inexpressibly fœtid *something* which gives the characteristic stench to sewers and drains. We do not say that this is *the* poison, but every medical man must have had cases in which a patient has caught the smell of an open drain in passing along the street, and has almost immediately been seized with sickness and diarrhœa. Whatever it is, however, it cannot yet be separated. It goes with the carbonic acid when the latter is removed by means of potash, which seems to show that it may be an organic acid.

Again, in collecting the ammonia from Thames water or sewage by distilling into dilute hydrochloric acid, we obtain a solution which, evaporated carefully to dryness, leaves a bright yellow residue, evidently containing something more than chloride of ammonium. We mention these things only to show Dr. Parkin that all the individual products of animal and vegetable decomposition are not yet known; and that there are many more compounds formed than the gases he has mentioned.

We cannot enter into the question as to what may be the poison of malaria, which is usually assumed to be the product of vegetable decomposition. Whatever it may be, it is proved to be without smell, and must be insoluble in water, although aqueous vapour would appear to be the carrier.

The theory of vegetable decomposition Dr. Parkin rejects, but has his own explanation which we give in his own words. "The process which produces malaria must take place beneath, not above, the surface. Now there is only one process that takes place beneath the surface, and which gives rise to the production of poisonous elements, independently of the decomposition of organic matter; and that process is what has been termed volcanic action." And again: "all general and specific diseases, or in other words epidemics and endemics are due to the extrication of a gaseous substance from the interior to the exterior of the earth."

And now for the cure. As there is no possibility of extinguishing those subterranean fires, it would seem to be a hopeless business; but Dr. Parkin consoles us with the assurance that we have efficient remedies at our hand on the surface of the earth. We must pave our towns to render the extrication of the morbid agent impossible; embank our rivers, so that the surface may always be covered to low water mark, thoroughly drain our marshes, or if that be impossible, flood them. Where neither of these things can be done, strew the ground with fresh burnt charcoal to absorb the poison as it rises; and if this be not possible, light fires and develope carbonic acid, which "is a certain antidote."

In conclusion we have to thank Dr. Parkin for a well-written, interesting, and suggestive book; but we feel bound to correct a mis-statement in the appendix. He says that "the quantity of organic matter contained in the sewers is utterly insignificant when compared to that which the Thames holds in solution." How then can he account for the fact that water taken from the middle of the river at Isleworth, which could not be affected by London sewage, contained only 1·17 grains of organic matter to the gallon, while that taken in the middle of the river at London Bridge about the same time contained 6·85 grains to the gallon? It is unfair also to take the contents of the Earl sewer as a fair sample of London sewage. If Dr. Parkin had looked further along the table, from which we imagine he quoted, he would have seen that the Northumberland Street sewage contained 88·76 grains of organic matter in the gallon, and that the Savoy Street sewer had on one occasion as much as 108·48 grains in the gallon.

An Improvement in the Manufacture of a Manure from Sewage Waters, and other Fluids containing Ammonia or Nitrogenous Matter. G. L. Blyth.

It is well known that the valuable constituents of sewage are the phosphates, ammonia, and the organic matters it contains. Mr. Blyth's invention consists in precipitating the phosphates, a large percentage of the ammonia, and all the insolublé organic matters, by means of a soluble or super-phosphate of magnesia. "When super-phosphate of magnesia is added to sewage it neutralises the ammonia, forming

an insoluble triple phosphate of magnesia and ammonia, which is precipitated or thrown down out of the liquid. If sufficient ammonia be present in the sewage to neutralise the whole of the super-phosphate added, it is all precipitated and carries with it all the insoluble and nitrogenous matters held in suspension in the sewage; but if the sewage has not undergone such decomposition so as to give rise to the formation of ammonia, then it will be necessary to add some other alkali, as, for example, lime in sufficient proportion to neutralise the whole of the excess of acid, which kept the super-phosphate in a soluble state. The precipitate is a valuable manure, while the supernatant liquor, being freed from ammonia and nitrogenous matters, liable to undergo putrefaction, becomes deodorised, and may be applied either to the irrigation of land, or run off into the ordinary channels of drainage without fear of creating any nuisance or offence."

The super-phosphate of magnesia the inventor prepares by the mutual decomposition of the super-phosphate of lime (prepared from bones, bone-ash, apatite, coprolites, &c.) and a salt of magnesia. A given proportion of this super-phosphate is mixed with the sewage, and if it remains acid sufficient lime is to be added to render the whole alkaline. The mixture is now violently agitated for a few minutes, and the result is a curdy precipitate which quickly subsides, carrying with it, as a clarifier, all the insoluble matters which may have been held in suspension.

One great advantage this process has over most others which have been invented, is that the matter added to the sewage is in itself a valuable manure.

The great obstacle to the profitable treatment of sewage is the excessive dilution—the excreta of each individual being mixed with about 23 gallons of water, exclusive of the rain fall. In this state, however, one experiment made with this process gave a deposit containing 4·5 per cent. ammonia, 3·66 per cent. of phosphates, with 58·11 per cent. organic matter; a result which, if constant, would yield a fair profit on the working. The Metropolitan Board ought to give this process a trial on a liberal scale.

CORRESPONDENCE.

Chemical Notices from Foreign Sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

New Carburetted Hydrogen.—At the last meeting of the *Société Philomatique* of Paris, M. Berthelot[1] announced that he had discovered a new gas, which he calls quadricarburetted hydrogen, and which is represented by the formula, C_4H_2. This gas is produced by the decomposition of alcohol and ether at a red heat. Its properties resemble for the most part those of olefiant gas. The author will describe them in detail as soon as he has succeeded in obtaining this new gas in a perfectly pure state, as well as the various compounds to which it gives birth.

Oxysulphuret of Antimony.—M. Jacobi[2] has made known in France the art of preparing and preserving oxysulphuret of antimony according to the Prussian pharmacopœia, which gives a receipt for a very fine product.

1500 parts of ordinary carbonate of soda are dissolved in 7500 parts of water; and to this solution are added 500 parts of lime, rendered semi-liquid by the addition of 1500 parts of water; to this mixture 100 parts of black sulphuret of antimony are added together with 125 parts of sulphur. The whole is boiled for an hour and a half, water being added now and then to replace that which is evaporated. The residue is again boiled with 3000 parts of water, the solution is then filtered and the filter washed with warm water. The liquid is allowed to rest, and the crystals obtained washed with distilled water, to which $\frac{1}{100}$ of potash is added, they are then dried. 500 parts of these crystals are dissolved in 2500 parts of water, the solution filtered and diluted with 12,500 parts of water. To this is added a mixture of 150 parts of sulphuric acid with 4000 parts of water. The precipitate formed is collected on a filter, washed first with ordinary water, then with distilled water, pressed between folds of blotting paper, dried at a temperature of 77° Fahrenheit, reduced to powder and preserved in a black bottle removed from the light. The drying at a low temperature, and the washing with distilled water, are two important conditions whereby the preservation of the product is assured.

Aluminium.—It will be perhaps interesting to notice here two new applications of this useful metal. The first is a chemical balance, entirely constructed in aluminium by MM. Collot frères of the Rue de l'Ecole de Medecine, the first of the kind ever produced. The second is the artificial arm of our excellent tenor Roger. It will be remembered that whilst out shooting M. Roger met with an accident which caused him the loss of his right arm. An artificial arm in aluminium has been made for him, the mechanism of which, constructed by M. Mathieu, is so perfect that every movement, every posture is easily practicable, and with the best opera-glass it is no easy matter to distinguish between the natural and the artificial member. M. Roger made his *rentrée* at the opera a few nights ago before a most enthusiastic assembly, and never was a more brilliant success achieved. When Wöhler first extracted aluminium in small globules from the chloride, he little thought that it was destined to play such a part upon the stage.

II. ORGANIC CHEMISTRY.

Tartaric Acid, Natural and Artificial.—A few months ago, M. Liebig, discovered a means of obtaining tartaric acid artificially, by the action of nitric acid upon sugar of milk, gum, &c. On that occasion M. Biot remarked how interesting it would be to determine whether the acid formed artificially had the same optical properties as the natural acid, which acted upon polarised light in a very peculiar manner. M. Bohor, in a short letter to M. Pelouze[3], has just shown that a solution of the artificial acid has precisely the same optical properties as a solution of the acid obtained from grapes or other fruits. The plane of polarisation is deviated *to the right* by both solutions; the succession of the coloured images when an analyser is affixed to the apparatus is the same for both acids; finally, both acids show the same peculiarly large deviation of the plane of polarisation, when they are mixed with a very slight quantity of boracic acid; a fact discovered by Biot, who observed, many years ago, that a trace of boracic acid added to a solution of tartaric acid caused an enormous increase in the deviation alluded to, and this phenomenon appears to be characteristic.

Oxalic Acid obtained from Chlorides of Carbon.—The production of oxalic acid by the action of sesquichloride of carbon upon an alcoholic solution of potash, was mentioned by M. Berthelot, in the *Annales de Chimie et de Physique*, 3e série, liv. p. 87. M. A. Geuther, has lately published a note upon the same subject. When a mixture of sesquichloride of carbon C_4Cl_6 and pulverised hydrate of passia (1 eq. of the first for 8 eq. of the second), is heated for some days in an oil-bath to 210° or 220° (Centigrade), there is formed a mixture of chloride of potassium and oxalate of potassa without any other product:

$$C_4Cl_6 + 8KO.HO = 2(KO.C_2O_3) + 6\,KCl + 8\,HO.$$

When 1 equivalent of protochloride of carbon $C_4\,Cl_4$ is heated for some time to 200° (C.) with at least 6 equivalents of pulverised hydrate of potash, oxalate of potash is likewise formed, and hydrogen gas evolved.

$$C_4Cl_4 + 6\,KO.HO = 2\,KO.C_2O_3 + 4\,HO + 2\,H.$$

Synthesis of Oxygenated Bases—Artificial Alkaloids.—M. Wurtz[4] has shown recently, that oxide of ethylen can be united directly with water, and form mono-

[1] *L'Institut*, 21 Décembre 1859.
[2] *Journal de Pharmacologie*, Bruxelles, Novembre 1859.
[3] *Comptes-Rendus*, 5 Déc. 1859.
[4] *Annalen der Chemie und Pharmacie*, cxl. p. 174.

ethylenic alcohol (glycol) diethylenic and triethylenic alcohol, according as these combinations take place between 1, 2, or 3 atoms of oxide of ethylen and 1 atom of water,

The same author[5] now makes known that oxide of ethylen will unite with ammonia without elimination of water; that is, all the elements of oxide of ethylen combine with all the elements of ammonia and form oxygenated bases remarkable for their energetic properties. To prepare them, oxide of ethylen is added to a concentrated solution of ammonia, and the mixture left to itself. If care be not taken the whole explodes with a powerful detonation, for the reaction produces much heat. When the experiment is conducted properly a syrupy alkaline matter is obtained. This is neutralised with hydrochloric acid, and the solution, sufficiently evaporated, produces colourless rhombohedric crystals which contain:[6]

$$C_6H_{15}NO_2, HCl.$$

A solution of these crystals forms a double salt with chloride of platinum. The supernatant liquid from which the crystals in question have been deposited contains another chloride, which cannot be crystallised, but which gives also a double salt with chloride of platinum.

The first platinum salt contains the elements of 1 atom of ammonia and 3 atoms of oxide of ethylen; the second platinum salt contains the elements of 1 atom of ammonia and 2 atoms of oxide of ethylen.

We have therefore two new oxygenated bases:

1st. $2C_2H_4O + NH_3 = C_4H_{11}NO_2$

Oxide of ethylen,

2nd. $3C_2H_4O + NH_3 = C_6H_{15}NO_3$

which in the state of chlorides combine with chloride of platinum, as chloride of ammonium, of potassium, &c., do. There seems to be no reason why compound ammonias should not react in the same manner; and the above furnishes us, doubtless, with reactions which will become a fertile source of artificial oxygenated alkaloids; moreover, they seem to confirm an idea conceived by Berzelius, that alkaloids contain ammonia already formed.

III. CHEMICAL ANALYSIS.

To discover Mercury in Milk.—When mercury is contained in milk in very slight quantity it is difficult to demonstrate the presence of this metal.

M. Personne[7] has recently made known a process by which traces of mercury may be distinguished in the above liquid. A current of chlorine gas is passed into the milk until all the casein is separated, the liquid is then filtered and the excess of chlorine removed by sulphurous acid or by a sulphite; the mercury is then precipitated by hydrosulphuric acid, the operation proceeding slowly and in a corked bottle. The precipitate obtained is washed by decantation, collected in a small capsule and dried in a water-bath. It is then introduced into a tube and covered with lime, the tube being bent U-shaped. This little apparatus is then heated to redness, beginning at the lime and finishing with the precipitate. The characteristic reaction with a blade of gold can then be made, the amalgam obtained being decomposed by heat.

SCIENTIFIC NOTES AND QUERIES.

Syrup of Iodide of Iron.—Sir,—In answer to *B. C.* p. 24, I can say that pretty much the same thing happened to me once with a strong solution of iodide of iron which I prepared. I made my solution with iron filings, and I am inclined to think that they must have had some brass filings among them. I believe that it is a subiodide of copper which is held in solution by the iodide of iron until the solution is diluted. I threw away my solution, and would recommend *B. C.* to do the same with his syrup, unless he feels inclined to make a good analysis of it.—*Pharmaceutist.*

[5] *Comptes-Rendus*, 5 Décembre 1859.
[6] C=12, H=1, N=14, O=16.
[7] *Journ. de Pharm.* Bruxelles, Oct. 1859.

Purification of Water by means of Oxides of Iron.—Sir,—In the first article of your second number, I observe the following:—"But M. Kuhlmann's paper also suggests that the destructive action of the sesquioxide may be employed for a very useful purpose. He found that the hydrated oxide agitated with water, coloured by various organic matters energetically decolorised it; a fact which leads us to suppose that it might be a valuable agent in the purification of water for the supply of towns. To this part of the subject we intend to return on an early occasion." Perhaps you will not deem it out of place if I take this still earlier occasion of informing you that I have publicly applied the oxide of iron to "the purification of waters for the supply of towns" since 1857, the experiments for which were known to be made long before.

I also claim to be, to the best of my knowledge, the first who gave public expression to the idea of the use of oxide of iron in connection with the purification of water and some other bodies.

It is at the same time impossible for me to know what private "laboratory notes" do exist, which read *now*, may appear suggestive of the same thing, but which very often do not see the light until after the practical accomplishment of the facts to which they are supposed to refer. Nor have my investigations and practice been confined in the same course to oxides of iron alone, as my publications show.

I may further mention that my patents in reference to the purification of water and several other bodies by these means have been translated and in print in France and Germany for nearly two years; the subject, therefore, is not necessarily a new one to M. Kuhlmann.

Allow me to add in reference to the practical value of his paper (as I read it in your translation) that every one in this country practically acquainted with shipbuilding, and many that are not, are fully aware of the extent of the destructive action of iron bolts and fastenings on the timber of ships. Certainly, the people at "Lloyds'" are, if none else. Were this circumstance not well known, should we so often see vessels advertised as being "copper bolted and fastened"? On the other hand, destructive as iron is known to be under these circumstances (M. Kuhlmann must have examined very extreme cases), yet where its effects pervade the timber, it is, so far, a check to that greater destructive action—dry rot.

I may say in conclusion that M. Kuhlmann seems to be in error with regard to the primary nature of the action of these oxides on timber.—*Thomas Spencer.*

P.S.—I had almost forgotten to say that a sesquioxide of iron, even when "hydrated," is an impracticable purifier of water.

On the detection of Arsenic in Criminal Cases.—Sir,—Circumstances irrespective of the late trial of Smethurst having directed my attention to the object of the detection of arsenic, I have learned some facts which may perhaps be useful to the medical and legal professions in future cases of poisoning by that substance.

It will be in the recollection of your readers, that a considerable discussion arose out of Dr. Taylor's use of the wire gauze in the detection of arsenic after Reinsch's test, which by immersion for a longer or shorter period, according to circumstances, in any liquid supposed to contain arsenic, and acidified with hydrochloric acid, becomes coated with a steel-like crust of other metal, possibly either arsenic or antimony, for both give similar deposits; but although, as I have proved, the sensitiveness of Reinsch's test is such as to enable us to detect the *millionth* part, equal to a grain diffused through as many as 15 gallons of water, *when we know it to exist* or to have been put there, yet its only use is as a *kind of guide* for further operations with a view to determine the precise nature of the matter—its actual quantity being afterwards ascertained by other means.

Sensitive, however, as Reinsch's test may be, it applies more particularly to arsenious acid and its compounds. Arsenious acid, commonly known as white arsenic, is an oxide of the metal arsenic, consisting of 1 equivalent or proportion of arsenic and 3 of oxygen, and is only sparingly soluble in water, but when searched for by Reinsch's test (if it exist at all) it may be expected to show itself on very bright copper in from 5 seconds to as many minutes, according to the quantity contained.

But it is otherwise with *arsenic acid* and its compounds, which differ from arsenious acid in that they are not only more highly oxidised substances, containing nearly twice as much oxygen, but are *far more soluble and virulent in their effects upon animals*; and it is in consequence of this oxidisement that a layer of metallic arsenic is not *so readily* obtained by Reinsch's test as with arsenious acid and its preparations, that many persons,

failing within a certain time to detect its presence, may be disposed to put *a negative* construction upon it, when the poison may exist there to a greater extent than they are aware of, and by continuing the operation or adopting some other method it can be easily found.

In Smethurst's case it was put forward as a new theory that because arsenic was found in one instance, and not in another, the chlorate of potash (also found in the liquid) must have interfered in such a way as to have prevented its detection—nay, I should rather have said, *its precipitation by Reinsch's copper test only.*

Chlorate of potash, by its oxydising tendency, certainly does hold up the arsenic in solution, as well as corrode the copper, to such an extent as to impart a strong green colour; nevertheless if arsenic exist at all, it may be detected by the evaporation of the green liquid to absolute dryness, mixing the resulting brownish red-coloured residue with powdered charcoal in a test tube, and submitting it to a strong heat, when the arsenic ought to show itself inside the bottom of the glass, on cooling, as a white saline crust.

If this crust be boiled with a sufficient quantity of water, so as to dissolve it, and the liquor filtered from the charcoal, acidulated with a few drops of *pure* hydrochloric acid, then boiled with a piece of very bright copper wire immersed in it, the copper will soon become coated with a steel-like layer of metallic arsenic, which can be sublimed into a white powder (arsenious acid) and on this being dissolved in distilled water, the addition of a drop or two of liquid nitrate of silver produces a characteristic yellow precipitate: the sensibility of this test being equal to 150,000th, *i. e.* a grain diffused through two gallons of liquid would be rendered evident.

In making this communication I wish to be distinctly understood as having no intention to cast any reflection upon parties concerned in Smethurst's case, but simply to relate, for the benefit of others, the facts as they have occurred to me in actual practice.—*John Horsley, F.C.S.*

Laboratory, Cheltenham.

Oak Rot.—A correspondent (*J. D.*) wishes to know if any of our readers can inform him why it is that oak rots *green*. He has noticed it in considerable quantities in the oak plantations at Lynmouth, and also at Tunbridge Wells. Is it, he asks, a chemical action? or is it caused by the growth of fungi?

LABORATORY MEMORANDA.

Pure Benzole from Coal-naphtha.—The sulphite of phenyle and ammonium $C_{12}H_5.NH_4.2\,SO_2$, usually called sulphobenzolate of ammonium, yields a very large proportion of pure benzole when submitted to dry distillation. The hydrocarbon thus procured can hardly be distinguished from the benzole obtained by heating benzoic acid with lime. Its odour is etherial, almost fragrant; and its boiling point is constant at 80°·3. A chemist well acquainted with the ordinary benzole obtained from coal-naphtha, to whom I showed a specimen of the benzole thus prepared from the sulphobenzolate of ammonium, scarcely recognised it as the same substance, so pleasant was its odour.

To prepare the sulphobenzolate, the purified benzole of commerce is dissolved, with the aid of a gentle heat, in a slight excess of fuming sulphuric acid; if ordinary oil of vitriol be employed, a much larger quantity of the acid is required. The acid liquid, after having been heated in the water bath for some time, is allowed to cool, and then diluted with water. Commercial carbonate of ammonium, together with some ammonia water, is to be added till the solution is slightly alkaline. The whole is now evaporated to dryness on the water-bath, and the dry mass exhausted with boiling alcohol. The greater part of the sulphate of ammonium remains in the residue. The alcoholic solution of the sulphobenzolate of ammonium is to be transferred to a retort, and submitted to distillation. When all the alcohol has distilled over, the receiver is changed, and the heat raised. The benzole which collects in the receiver is accompanied by small quantities of solid products and by water. From these it may be separated by the addition of a strong potash-solution, and the removal of the supernatant oil by the pipette. The benzole is then rectified off caustic potash. The benzole thus produced is perfectly pure; and although the quantity obtained is not very large, yet the result of the process is exceedingly interesting to the chemist, since it removes all doubt concerning the identity of the benzole from coal-naphtha and similar sources with that obtained from benzoic acid.—*A. H. Church.*

MISCELLANEOUS.

The Bath-bun Poisoning Case.—A case of wholesale poisoning which has occurred within the last day or two at Clifton demands from us more than a passing record. A baker in that place, wishing to save his eggs and exaggerate his reputation, desired some yellow colouring matter to give a fictitious appearance of richness to his Bath-buns. Low eating-house keepers and cheap pastry-cooks in London have long been in the habit of using turmeric to give this appearance to their delicacies, but the Clifton baker was not sufficiently well up to the tricks of his trade as to be aware of the uses of this harmless drug. Casting about, therefore, for some substance which would answer his purpose, he by some means fixed his mind on chrome yellow—chromate of lead. For this he applied to a druggist in his neighbourhood. A druggist who was not a colourman as well would not be likely to have chrome yellow in his shop, and this would appear to be the case with the Clifton tradesman. Accordingly, he sold the baker what he thought would answer the purpose of a yellow colouring matter just as well; and that substance was ORPIMENT! This the baker carried home, mixed in his buns, and sold them to his unsuspicious customers. The consequences were soon apparent. The first victims were some school boys, one of whom, with a good appetite and much pocket money, devoured three of the poisonous viands. They were all made exceedingly ill, and some narrowly escaped with their lives, Such is a simple narrative of this shameful case, in which it is hard to say which was most to blame, the baker who designed to put chrome yellow into his pastry, or the druggist who sold him *orpiment* instead of the less active poison.

Moulding Fruits and Insects in Metal.—Small castings of iron, copper, or any other metal, may be made in moulds composed of plaster of Paris. Such moulds are easily made, and are very suitable for such articles. Fac-similes of birds, flowers, fruit, and insects may be cast in plaster of Paris as follows: Make a tight box of boards, with two or three wooden pins in it, and suspend in it, by a piece of strong linen cord, the objects of which casts are desired; then take five parts of plaster of Paris and one of brickdust, make them into a paste of the consistency of cream, and fill the box up carefully so as to cover the objects without distorting them. The box—with the articles in the interior of the plaster—is now suffered to dry very slowly, it is then placed in a slow fire, the heat of which is increased gradually until the box is consumed, and the plaster heated red-hot. It is now to be taken out of the fire, and the places where the wooden pins were inserted will form small holes, opening into the interior. The place which was occupied by the leaves, flowers, or insects will be found to contain only ashes, which may be blown through the above-named holes with a pair of bellows, leaving a space inside of the form of the object to be cast. A small quantity of mercury may now be poured in through the hole left by the burnt cord; and upon shaking the ashes will be collected, when they may be all poured out through the holes. The molten copper or brass is now poured in by a jet through the hole, which may be enlarged for the purpose, and the air will pass out by the small opening left by the cord. When the metal is cold, the mould of plaster is broken and the casting taken from its interior. Groups of fruit, flowers, lizards, and frogs have been cast by this process with an exact faithfulness to nature.

ANSWERS TO CORRESPONDENTS.

Mr. A. W. P. Smith is thanked for his good wishes.

R. B. C.—1. When absolutely pure there is no difference; but corn spirit, unless highly rectified, usually contains some *fusel oil*, to which the disagreeable effects of that spirit are generally referred. 2. To detect strychnine in mice or other small animals, dry the stomach and bowels, with the contents and liver, carefully, and then break them up and digest in chloroform. Afterwards take some of the chloroform, and evaporate on a watch-glass. When dry, place the glass on white paper, and add a few drops of strong sulphuric acid and a small fragment of bichromate of potash, whereupon a bluish violet colour is produced, which passes into a reddish yellow, and finally becomes brown.

S. S.—Oxygen is obtained by heating binoxide of manganese, and hydrogen is obtained when zinc, water and sulphuric acid are brought into contact. Our correspondent should consult some elementary work on Chemistry. The mixture of the gases is highly explosive.

W. M. (Manchester).—*W. W. S.*—*Laybourn*—*H. N. Draper*—*G. B. Buckton*—received.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business* communications to the PUBLISHER, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

VOL. I. No. 5. — January 7, 1860.

PROPOSED TOXICOLOGICAL COMMISSION.

TOXICOLOGICAL science has of late years made great advances, and as far as inorganic poisons are concerned, it may almost be regarded as perfect. By a few experiments with trustworthy reagents, in the hands of a competent and conscientious chemist, the presence in the body of the smallest quantity of a mineral poison which can destroy life or even affect health, is easily and distinctly demonstrated beyond the possibility of a doubt. It is otherwise, however, with the organic poisons. Although some of these are easily recognised, there are many which we have at present no means of identifying, and we lately saw in the Poplar case the prisoner acquitted merely for the want of this positive identification. With regard to this particular case, we may remark, that a substance possessing all the physical characters of the matter which Dr. Letheby extracted from the stomach of the deceased, and capable of producing all the symptoms of which she complained, may be extracted from the shell of the cashew nuts which are commonly sold about the streets of London. It was introduced into medicine a few years ago as a vesicatory, under the name of *Cardole*, but it is little known to the medical profession. The acrid properties of the nutshell, however, are well known to children, who have blistered their mouths in extracting the kernels. Cardole, as usually prepared, though proving fatal to small animals, does not kill them so rapidly as the matter Dr. Letheby obtained from the stomach of the victim in the Poplar case; but it is likely that the means by which the doctor separated the poison may have procured it in a purer and more concentrated form. The subject certainly deserves further investigation, for here is a dangerous poison within the reach of any one who is acquainted with its properties, and wicked enough to make use of them.

We have made these observations partly with the view of introducing the following suggestion made in the last number of our valued contemporary, *Chambers's Journal*, a suggestion well deserving the attention of the public and the Government:—

"The recent poisoning cases, though no longer exciting public attention, are not forgotten among those by whom it is most to be desired they should be remembered — namely, men of science; for if it be true that the poisoner's skill has outrun the means of detection, so much the more need is there that chemistry should make a step in advance. This step, however, can only be made after a series of experiments of a highly refined character have been carried out; such as will enable the chemist in his laboratory to detect the subtlest cases. Results of this importance, involving a considerable amount of expense and labour, are beyond what we commonly expect from spontaneous individual research; and the subject is felt to be one which should be taken in hand by government. Let the proper authorities appoint a commission of two or three of our most competent chemists to work out a more perfect method of analysis than that at present in use, and pay them sufficiently, and there is good reason to believe that the result would be accomplished. Seeing that the public at large would be benefited by the result, there seems nothing unreasonable in looking to the public purse for payment; yet, taught by experience, no one is solicitous to bring the question forward, seeing how prone some feeble-minded members of parliament are to get up and oppose any scientific grant, especially one for the purpose of testing the effects of poison on animals, by the remark, at which the House is sure to laugh, that 'We don't want the public money wasted in poisoning dogs and cats.' It is only at times, and by a struggle, that the thousand pounds set down in the estimates for the encouragement of science does actually get voted; and yet the appropriation of that sum has hitherto rendered singular service to the mechanical, astronomical, and physical and chemical sciences. The poison-question is, however, of that importance that we trust it will not be allowed to slumber; and we make these remarks in the hope that it will be kept awake. We recommend it as a proper one for discussion to the CHEMICAL NEWS, a periodical which is to be supported by chemists in all parts of the realm."

Our toxicologists are real detectives, and the suggestion ought to be carried out merely as a matter of police. What is wanted is a general scheme for a complete examination of any suspected matters *for all known poisons*, and we are confident that we have toxicologists who could supply us with this, if they had any inducement to devote the time and labour which would be required for the preliminary researches. There can be no doubt that the best preventative of crime is certainty of detection; and nothing would do so much to stop poisoning as the knowledge that the poison is sure to be discovered.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Method of separating Phosphoric Acid from Bases, and principally from Alumina and Iron, by M. SCHULZE.

THE following method has been adopted by the author for the estimation of phosphoric acids in soils. We take about 50 grammes (770 grains) of the earth, and ignite it to destroy the organic matters, and then dissolve it in hydrochloric acid. The filtered liquor is nearly neutralised by dilute ammonia, care being taken not to reach the point when the precipitate of oxide of iron becomes permanent. The solution ought now to amount to about a pint and half. We now add 35 or 45 drops of perchloride of antimony, and set it aside for 12 or 24 hours. During this time there is deposited a yellowish-white flocculent precipitate which contains all the phosphoric acid, but is principally composed of antimonic acid, carrying with it some oxide of iron and alumina; it contains besides a quantity of ammonia, in proportion to that of the phosphoric acid. The precipitate, well washed with distilled water, is boiled with soda ley containing a certain amount of silicate. After boiling, the liquid is filtered; the oxide of antimony, changed into antimoniate of soda, remains on the filter with the alumina and oxide of iron. The filtered alkaline so-

lution, which contains the phosphoric acid with a little alumina and silica, is supersaturated with hydrochloric acid and ammonia, concentrated to evaporation, again treated with ammonia and then filtered. The precipitate of alumina and silica thus obtained, carries with it a small quantity of phosphoric acid. To remove this, the precipitate is redissolved in a drop or two of hydrochloric acid, the solution is evaporated to dryness, and the residue is warmed with a little acidulated water. After having filtered again to separate the silica, a small quantity of tartaric acid is added to the filtered liquor, which is then mixed with the preceding ammoniacal solution containing the greater part of the phosphoric acid. From these solutions the phosphoric acid is separated as phosphate of magnesia and ammonia in the usual manner.—*Annalen der Chemie und Pharmacie*, B. CIX.

TECHNICAL CHEMISTRY.

On the Ventilation of Sewers, by FREDERICK J. BURGE, *V.P. Metropolitan Association of Medical Officers.*

AT a time when all the engineering talent of the day has been endeavouring to solve the great question as to what is the best mode of conveying away the solid and liquid sewage of London, the chemical world has been, and must yet continue to be, actively engaged with the almost equally difficult problem, how to dispose of its gases generated *in transitu*.

That the passage of the sewage matter through the great culverts now being constructed upon improved principles, and with uniform falls, will be much more rapid than through the old and imperfect ones is to be fairly anticipated, but as the new system of house drainage, with its more complete trapping, will almost entirely prevent the escape of gases by the thousands of openings through which they have hitherto found vent, it will render it imperative that the arterial trunks shall be provided with an apparatus which, whilst it will offer no injurious impediment to the free passage of air from the sewers, will accomplish the chemical destruction of their deleterious gases.

In the early part of the year 1858 this subject engaged the attention of the Sanitary Committee of the Board of Works of the Fulham District, and Mr. Bean, their surveyor, and myself, their medical officer of health, were required to report thereon. The apparatus originally suggested by Mr. Bean consisted of a cast-iron box of about 18 inches cube, divided into two compartments and fitted with a cradle, which was destined to contain lime and charcoal broken into small pieces and mixed together, through which the gases would have to pass and be deodorised thereby. As it appeared to me, however, subsequently that several other deodorising agents might be made available, I proposed the substitution of a series of trays or a series of metal tubes placed side by side in a vertical position, with perforated bottoms for ensuring the more perfect and uniform contact of the sewage emanations with the disinfectant.

The apparatus is designed to be placed on the top of the common ventilating shaft in the centre of the roadway, and when in use presents the appearance of an ordinary grating.

The chemical agents which have principally engaged my attention at present have been—

1. Lime mixed with ordinary charcoal, as originally proposed by Mr. Bean, and exposed to the sewer emanations by means of his "cradle."

The whole of the sulphuretted hydrogen may thus be decomposed, and, I believe, some of the other gases decomposed or absorbed.

2. The oxides of iron, mixed with sawdust.

These agents have been most successfully used in the purification of coal-gas by the Imperial and other Gas Companies, which suggested to me the idea that, by the adaptation of a series of trays to the apparatus, so arranged as to ensure the perfect transmission of the entire sewer air through them, this mixture would form an admirable material for securing the object.

3. The oxides of iron, mixed with coarsely-powdered charcoal.

The operation of these would be somewhat similar to the preceding. There is, however, this drawback to the foregoing substances, that although the sulphuretted hydrogen and sulphide of ammonia would be totally annihilated, there are other gases arising from the decomposition of organic matter, which might possibly remain unaffected by them.

4. The manganate and permanganate of potass.

These constitute the active principles in Condy's disinfecting fluid, and form an admirable means for destroying impure gases. They, however, with others, have hitherto ranked only amongst the strictly *local* disinfectants, and from their non-diffusable nature could not be satisfactorily applied to the gases pervading the atmosphere of large sewers.

The mode by which I think they can be made available is by saturating very coarsely-powdered charcoal with a rather strong solution, and securing the passage of the sewer air through the material by means of the series of trays or metal tubes before alluded to.

The above chemical agents are none of them new, but are all well tried servants in sanitary science; nevertheless, though they have been used as disinfectants in the ordinary manner, none have as yet been applied to the decomposition of sewer gases in an apparatus so fraught with advantages as that suggested by Mr. Bean and myself. The manner in which they have been generally used has been by merely suspending flannels, &c. saturated with the various solutions, either in the sewers or ventilating shafts, necessarily allowing a very large proportion of the gases to escape, without contact with the disinfectant, a circumstance which it is believed will be avoided by the use of the proposed apparatus.

A very important advantage in it is that its action is entirely on the gaseous matters, that no extraneous substance is added to the contents of the sewers, and that it can with facility be applied to any of the existing shafts.

In order to test the efficacy of the principle, I had recourse to a series of laboratory experiments. An apparatus was fitted up for the purpose of generating sulphuretted hydrogen, to which a glass tube was adapted dipping into a receiver containing some very offensive cesspool matter in an active state of decomposition. To this receiver was connected another glass tube of large diameter placed horizontally, and containing small lumps of lime and charcoal through which the compound gases were made to pass. To this was attached another tube dipping into a saturated solution of acetate of lead. The evolution of sulphuretted hydrogen in this operation was continued for several consecutive hours, without the slightest discoloration of the lead solution. The results most fully demonstrated the practicability of entirely destroying the sulphuretted hydrogen, and fixing the ammonia. The only objection to the use of this mixture of lime and

charcoal is the occasional slacking of the lime from the humid air of the sewer and the water generated in the process and the subsequent condensation of the moistened powder.

In many later experiments the same kind of apparatus was used, substituting as the deodorising material oxide of iron mixed with coarse sawdust, in some instances the oxide mixed with small pieces of charcoal, and in other cases charcoal alone saturated with Condy's fluid. In nearly all the cases the results were highly satisfactory, the lead solution remaining perfectly clear. The experiments were varied in every possible way: sometimes the dipping tube, instead of being inserted into the solution of lead, was introduced into a vessel containing water only; and at others, opening into the room; but neither did the water nor the air of the apartment acquire any unpleasant smell.

In my next series of trials, I used the original wooden model, with trays and tubes closely fitted and cemented to prevent the escape of any of the gases, and subsequently applied one constructed of zinc to the crown of a large and very offensive cesspool.

During the early part of the year 1859, the Board of Works of the Fulham District ordered two of these ventilators to be cast in iron, and fitted to the shafts of one of the main sewers in Hammersmith. Upon these I have been successfully at work throughout the whole of the past summer.

Coincident with my experiments, Mr. Bean has caused an investigation to be made periodically by the person in charge of the sewer, with reference to its condition as indicated by the sense of smell, and for the purpose of ascertaining whether any change for the worse had occurred in consequence of the use of the apparatus. These examinations testify that the air of the sewers will not be in any way injuriously affected, and that whilst almost, if not quite, the whole of the nuisance arising from the old mode of ventilating them will by this means be annihilated, no impediment of consequence will be offered to the passage of the gases, neither can any ill consequence be expected to affect the workmen employed in cleansing or repairing them. An inquiry in the neighbourhood where the ventilators were used, satisfies me also that no injurious influence has been exerted on the house drains in consequence of my experiments.

In the present system of ventilation, it is found that in consequence of the iron gratings communicating directly with the sewer, a very large deposit of *débris* from the roadway takes place in that portion of it immediately underneath, particularly where the current is sluggish, and causes in many instances a great impediment to its proper flow. The catchpit which forms part of the deodoriser entirely obviates this evil, and is in itself a most important improvement.

If the apparatus now under notice fails to accomplish all that can be desired, I am quite certain that it will be instrumental in diminishing to a most sensible extent the offensiveness of the ventilating shafts; that its cost will not be excessive, and that the expense of maintaining it in action will be trifling compared with the advantages obtained. The charcoal may be washed and used almost *ad infinitum*. The oxide of iron may be revived by exposure to the air, and used for a very lengthened period, and even if Condy's patent solution were used, it may be purchased at a cost of about 1*s.* or 2*s.* per gallon.

Hammersmith, Dec. 1859.

[We insert the above communication as it contains some important points, but we believe the use of charcoal in similar trays has been made the subject of a patent.—Ed.]

PHARMACY, TOXICOLOGY, &c.

Leaves of the Castor Oil Plant.

The leaves of the castor oil plant, whether used internally or externally, are said to act as a lactagogue. At a meeting of the Medical Society of London, Dr. Routh exhibited three preparations of the leaves which had been made by Mr. Greenish, New Street, Dorset Square. These were a *tincture* and *liquor* (dose of each one drachm), and an extract (dose, five grains). The extract is made by evaporating a decoction to a proper consistence over a steam or water bath. The tincture is made with proof spirit, and is macerated the usual time; and the liquor may be prepared by percolation with cold water, a proper amount of spirit being added to preserve it, in the ordinary way.

The lactagogue properties of the leaves of the *Ricinus americanus* were known to the Spaniards of Peru and Chili. They applied them to the breasts to produce milk. Dr. McWilliam first drew the attention of the medical profession to the subject at the meeting of the British Association at Edinburgh, in 1850. The leaves of the plant are known at Boavista, in the Cape de Verd islands, as the *bofareira*, which is in reality the Ricinus communis of botanists, and occasionally the Jatropha Curcas, both belonging to the natural order of Euphorbiaceæ. Two kinds are known in these islands, the red and the white. The white only is used as a lactagogue. When the appearance of the milk is delayed, a decoction is made by boiling well a handful of the white *bofareira* in six or eight pints of spring water. The breasts are bathed with this decoction for fifteen or twenty minutes, and part of the leaves are applied as a poultice; the applications being repeated alternately for some hours, until the desired effect is produced.

Dr. Tyler Smith made some experiments with the plant used externally, and found it successful in three cases out of five.

Dr. Routh is the first who has used castor oil leaves internally in this country. He has given an infusion and also the extract in several cases with remarkable effect.

The leaves used by Mr. Greenish were obtained from Australia, from whence, if the medicine come into general use, any quantity may be obtained. The leaves grown in gardens here were not found so potent as those brought from Australia.

Adulterated Oil of Peppermint.

Adulterated oil of peppermint has been sold in the Philadelphia market within the last month or two. It is of a light yellow colour, but considerably darker than is usual with freshly distilled oil of mint, and presents the following characteristics: when evaporated from a piece of white unsized paper it leaves a yellow mark. Dropped into alcohol of 95 per cent. it does not disseminate itself, but falls to the bottom of the glass in broken globules, and collects in a distinct stratum.

Agitation produces dissolution, but the solution is turbid, with an amount of oil which should dissolve freely. It presents no reaction with chromic acid, but when dropped on a crystal of iodine, the iodine intumesces and fumes. No such reaction is produced by a pure oil of peppermint. The density of the oil is 0·870. A recent sample of Borton's oil gave a density of 0·90 These characteristics would point to turpentine as the probable adulteration. It has been suggested by a prac-

tised distiller of oil of peppermint that the adulteration was the essential oil of fireweed. This supposition was based on the peculiar strong smell left after most of the oil was volatilised from paper.

Recent oil of peppermint should volatilise completely from the paper without leaving a mark; when dropped into alcohol of 85 per cent. it should dissolve completely without agitation.—*American Journal of Pharmacy.*

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures[1] *(adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i. e. of such as are called the Physical or Inorganic Forces — including an Account of their Relations to each other; by* M. FARADAY, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R. I., Foreign Associate of the Academy of Sciences, Paris, &c.*

LECTURE I. (Dec. 31, 1859.) — *The Force of Gravitation.*

IT grieves me much to think that I may have been a cause of disturbance in your Christmas arrangements, for nothing is more satisfactory to my mind than to perform that which I undertake; but such things are not always left in our own power, and we must submit to circumstances as they are appointed. I will to-day do the best I can; I will ask you to bear with me if I am unable to give more than a few words; and as a substitute I will endeavour to make the *illustrations* of the sense I try to express, as full as possible; and if we find by the end of this lecture, that we may be justified in continuing them, thinking that next week our power shall be greater,—why then, with submission to you, we will take such course as you may think fit,—either go on or discontinue them: and although I now feel much weakened by the pressure of illness (a mere cold) upon me, both in faculty of expression and clearness of thought, I shall here claim, as I always have done on these occasions, the right of addressing myself to the younger members of the audience,—and for this purpose, therefore, unfitted as it may seem for an elderly infirm man to do so, I will return to second childhood and become, as it were, young again amongst the young.

Let us now consider, for a little while, how wonderfully we stand upon this world. Here it is we are born, bred, and live, and yet we view these things with an almost entire absence of wonder to ourselves respecting the way in which all this happens. So small, indeed, is our wonder, that we are never taken by surprise; and I do think, that, to a young person of ten, fifteen, or twenty years of age, perhaps the first sight of a cataract or a mountain would occasion more surprise in him than he had ever felt concerning the means of his own existence; how he came here; how he lives; by what means he stands upright; and through what means he moves about from place to place. Hence, we come into this world, we live, and depart from it, without our thoughts being called specifically to consider how all this takes place; and were it not for the exertions of some few inquiring minds, who have looked *into* these things and ascertained the very beautiful laws and conditions by which we *do* live and stand upon the earth, we should hardly be aware that there was anything wonderful in it. These inquiries, which have occupied philosophers from the earliest days, when they first began to find out the laws by which we grow, and exist, and enjoy ourselves, up to the present time, have shown us that all this was effected in consequence of the existence of certain *forces*, or *abilities* to do things, or *powers*, that are so common that nothing can be commoner: for nothing is commoner than the wonderful powers by which we are enabled to stand upright—they are essential to our existence every moment.

Now, it is my purpose to-day to make you acquainted with some of these powers; not the vital ones, but some of the more elementary and, what we call, *physical* powers; and, in the outset, what can I do to bring to your minds a notion of neither more nor less than that which I mean by the word *power* or *force*? Suppose I were to take this sheet of paper, and were to place it upright on one edge, resting against a support before me, (as the roughest possible illustration I can give of something to be disturbed), and suppose I pull this piece of string which is attached to it. I pull the paper over. I have therefore brought into use a *power* of doing so—the *power* of my hand carried on through this string in a way which is very remarkable when we come to analyse it; and it is by means of these powers conjoined together (for there are several powers here employed) that I pull the paper over. Again, if I give it a push upon the other side I, bring into play a *power*, but a very different exertion of power from the former; or, if I take now this bit of shellac [a stick of shellac about 12 inches long and 1½ in diameter] and rub it with flannel, and hold it an inch or so in front of the upper part of this upright sheet, the paper is immediately moved towards the shellac, and by now drawing the latter away, the paper falls over without having been touched by anything. You see—in the first illustration I produced an effect than which nothing could be commoner—I pull it over now, not by means of that string or the pull of my hand, but by some action in this shellac. The shellac, therefore, has a *power* with which it acts upon the sheet of paper; and as an illustration of the exercise of another kind of power, I might use gunpowder with which to throw it over.

Now, I want you to endeavour to comprehend that when I am speaking of a *power* or *force*, I am speaking of that which I used just now to pull over this piece of paper. I will not embarrass you at present with the *name* of that power, but it is clear there was a *something* in the shellac which acted by attraction, and pulled the paper over; this, then, is one of those things which we call *power*, or *force*; and you will now be able to recognise it as such in whatever form I show it to you. We are not to suppose that there are so very many different powers; on the contrary, it is wonderful to think how few are the powers by which all the phenomena of nature are governed. There is an illustration of another kind of power in that lamp; *there* is a power of heat—a power of doing something, but not the same power as that which pulled the paper over: and so, by degrees, we find that there are certain other powers (not many) in the various bodies around us; and thus, beginning with the simplest experiments of pushing and pulling, I shall gradually proceed to distinguish these powers one from the other, and compare the way in which they combine together. This world upon which we stand, (and we have not much need to travel out of the world for illustrations of our subject; but the mind of man is not confined like the matter of his body, and thus he may and does travel outwards, for wherever his sight can pierce, there his observations can penetrate) is pretty nearly a round globe, having its surface disposed in a manner of which this terrestrial globe by my side is a rough model; so much is land and so much is water, and by looking at it here we see in a sort of map or picture how the world is formed upon its surface. Then, when we come to examine further, I refer you to this sectional diagram of the geological strata of the earth, in which there is a more elaborate view of what is under the surface of our globe. For, when we come to dig into or examine it (as man does for his own instruction and advantage, in a variety of ways), we see that it is made up of different kinds of matter, subject to a very few powers; and all disposed in this strange and wonderful way, which gives to man a history—and such a history—as to what there is in those veins, in those rocks, the ores, the water springs, the atmosphere around, and all varieties of material substances, held together by means of *forces* in one great mass, 8000 miles in diameter, that the mind is overwhelmed in contemplation of the wonderful history related by these strata (some of which are fine and thin like sheets of paper), — all formed in succession by the forces of which I have spoken.

Now, I shall try to help your attention to what I may say, by directing, to-day, our thoughts to one kind of power. You see what I mean by the term *matter*—any of these things that I can lay hold of with the hand, or in a bag (for I may take hold of the air by enclosing it in a bag)—they are all portions of matter with which we have to deal at present, generally or particularly, as I may require to illustrate my subject. Here is the sort of matter which we call *water* — it is *there* ice [pointing to block of ice upon the table], *there* water—[pointing to the water boiling in a flask]—*here* vapour—you see it issuing out from the top [of the flask]. Do not suppose that that ice and that water are two entirely different things, or that the steam rising in bubbles and ascending in vapour *there* is absolutely different from the fluid water — it may be different in some things, having reference to the *amounts* of power which it contains; but it is the same, nevertheless, as the great ocean of water around our globe, and I employ it here for the sake of illustration, because if we look into it we shall find that it supplies us with examples of all the powers to which I shall here refer. For instance, here is water—it is heavy; but let us examine it with regard to the *amount* of its heaviness, or its gravity. You see here I have a little glass vessel and scales [nearly equipoised scales, one of which contained a half-pint glass vessel], and the glass

[1] Reported verbatim by special permission.

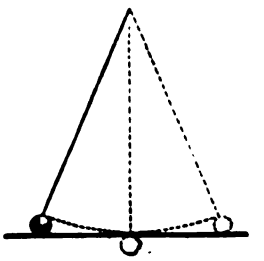
vessel is at present the lighter of the two; but if I now take some water and pour it in, you see that that side of the scales immediately goes down; that shows you (using common language, which I will not suppose for the present you have hitherto applied very strictly), that it is *heavy*, and if I put this additional weight into the opposite scale, I should not wonder if this vessel would hold water enough to weigh *it* down. [The Lecturer poured more water into the jar, which again went down.] Why do I hold the bottle *above* the vessel to pour the water into it? You will say, because experience has taught me that it is necessary. I do it for a better reason — because it is a law of nature that the water should fall towards the earth, and, therefore, the very means which I use to cause the water to enter the vessel are those which will carry the whole body of water down. That power is what we call *gravity*, and you see *there* [pointing to the scales] a good deal of water gravitating towards the earth. Now *here* [exhibiting a small piece of platinum] is another thing which gravitates towards the earth as much as the whole of that water. See what a little there is of it — *that* little thing is heavier than so much water [placing the metal in opposite scales to the water]. What a wonderful thing it is to see that it requires so much water as *that* [a half pint vessel full] to fall towards the earth, compared with the little mass of substance I have *here*; and again, if I take this metal [a bar of aluminium about eight times the bulk of the platinum] we find the water will balance that as well as it did the platinum; so that we get, even in the very outset, an example of what we want to understand by the words *forces* or *powers*.

I have spoken of water, and first of all of its property of falling downwards — you know very well how the oceans surround the globe — how they fall round the surface, giving roundness to it, clothing it like a garment; but, besides that, there are other properties of water. *Here*, for instance, is some quicklime, and if I add some water to it, you will find another power or property in the water. It is now very hot, it is steaming up, and if I had a bit of phosphorus here, or a match, I could perhaps light it. Now, that could not happen without a *force* in the water to produce the result; but that force is altogether very different from its power of falling to the earth. Then again here is another substance [some anhydrous sulphate of copper] which will illustrate another kind of power. [The Lecturer here poured some water over the white sulphate of copper, which immediately became blue, evolving considerable heat at the same time.] Here is the same water with a substance which heats nearly as much as the lime does, but see how differently. So great indeed is this heat in the case of lime, that it is sufficient sometimes (as you see here) to set wood on fire; and this is the reason of what we have sometimes heard, of barges laden with quicklime taking fire in the middle of the river, in consequence of this power of heat brought into play by a leakage of the water into the barge. You see how strangely different subjects for our consideration arise, when we come to think over these various matters — the power of heat evolved by acting upon lime with water, and the power which water has of uniting this salt of copper from white to blue.

I want you now to understand the nature of the most simple exertion of this power of matter called *weight* or *gravity*. Bodies are heavy—you saw that in the case of water when I placed it in the balance. Here I have what we call a *weight* [an iron half cwt.]—a thing called a weight, because in it the exercise of that power of pressing downwards is especially used for the purposes of weighing; and I have also one of these little inflated india-rubber bladders which are very beautiful although very common (most beautiful things are common), and I am going to put the weight upon it, to give you a sort of illustration of the downward pressure of the iron, and of the power which the air possesses of resisting that pressure — it may burst, but we must try to avoid that. [During the last few observations the Lecturer had succeeded in placing the half cwt. in a state of quiescence upon the inflated india-rubber ball, which consequently assumed a shape very much resembling a flat cheese with round edges.] There you see a bubble of air bearing half a hundred weight, and you must conceive for yourselves what a wonderful *power* there must be to pull this weight downwards, to sink it thus in the ball of air.

Let me now give you another illustration of this power. You know what a pendulum is. I have one here (*fig.* 1.) and if I set it swinging, it will continue to swing to and fro. Now, I wonder whether you can tell me why that body oscillates to and fro—that pendulum bob as it is sometimes called. Observe, if I hold this straight stick horizontally, as high as the position of the ball at the two ends of its journey, you see that the ball is in a higher position at the two extremities than it is when in the middle. Starting from one end of the stick, the ball falls towards the centre, and then rising again to the opposite end, it constantly tries to fall to the lowest point, swinging and vibrating most beautifully, and with wonderful properties in other respects—the time of its vibration and so on—but concerning which we will not now trouble ourselves.

Fig. 1.



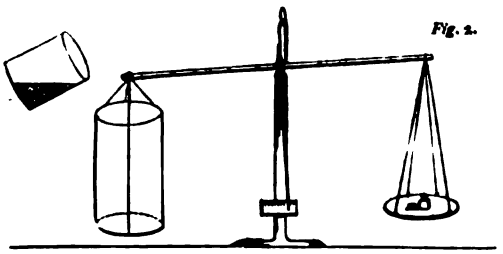
If a gold leaf, or piece of thread, or any other substance, were hung where this ball is, it would swing to and fro in the same manner, and in the same time too. Do not be startled at this statement; I repeat, in the same manner and in the same time, and you will see by and by how this is. Now, that power which caused the water to descend in the balance — which made the iron weight press upon and flatten the bubble of air—which caused the swinging to and fro of the pendulum, that power is entirely due to the attraction which there is between the falling body and the earth. Let us be slow and careful to comprehend this. It is not that the earth has any *particular* attraction towards bodies which fall to it, but, that *all* these bodies possess an attraction, every one towards the other. It is not that the earth has any special power which these balls themselves have not, for just as much power as the earth has to attract these two balls [dropping two ivory balls] just so much power have they in proportion to their bulks to draw themselves one to the other; and the only reason why they fall so quickly to the earth is owing to its greater size. Now, if I were to place these two balls near together, I should not be able, by the most delicate arrangement of apparatus, to make you, or myself, sensible that these balls did attract one another; and yet we know that such is the case because if, instead of taking a small ivory ball, we take a mountain, and put a ball like this near it, we find that, owing to the vast size of the mountain as compared with the billiard ball, the latter is drawn slightly towards it; showing clearly that an attraction *does* exist, just as it did between the shellac which I rubbed and the piece of paper which was overturned by it.

Now, it is not very easy to make these things quite clear at the outset, and I must take care that I do not leave anything unexplained as I proceed, and, therefore, I must make you clearly understand that all bodies are attracted to the earth, or, to use a more learned term, *gravitate*. You will not mind my using this word, for when I say that this penny piece *gravitates*, I mean nothing more nor less than that it falls towards the earth, and if not intercepted, it would go on falling, falling, until it arrived at what we call the *centre of gravity* of the earth, which I will explain to you by and by.

I want you, now, to understand that this property of gravitation is never lost, that every substance possesses it, that there is never any change in the quantity of it; and, first of all, I will take as illustration a piece of marble. Now this marble has weight—as you will see if I put it in these scales; it weighs the balance down, and if I take it off, the balance goes back again and resumes its equilibrium. Now I can decompose this marble and change it, in the same manner as I can change ice into water and water into steam. I can convert a part of it into *its own* steam easily, and show you that this steam from the marble has the property of remaining in the same place at common temperatures, which *water*-steam has not. If I add a little liquid to the marble and decompose it, I get that which you see—[the Lecturer here put several lumps of marble into a glass jar, and poured water and then acid over them; the carbonic acid immediately commenced to escape with considerable effervescence]—the appearance of boiling, which is only the separation of one part of the marble from another. Now this [marble] steam, and that [water] steam, and all other steams *gravitate* just like any other substance does; they all are attracted the one towards the other, and all fall towards the earth, and what I want you to see is that *this* steam gravitates. I have here (*fig* 2.) a large vessel placed upon a balance, and the moment I pour this steam into it you see that the steam gravitates. Just watch the index and see whether it tilts over or not. [The lecturer here poured the carbonic acid out of the glass in which it was being generated into the vessel suspended on the balance, when the gravitation of the carbonic acid was at once apparent]. Look how it is going down. How pretty that is! I poured nothing in but the invisible steam, or vapour, or gas which came from the marble, but you see that part of the marble, although it has taken the shape of air, still gravitates as it did before. Now,

will it weigh down that bit of paper? [Placing a piece of paper in the opposite scale.] Yes, more than that; it nearly weighs down

Fig. 2.



this bit of paper. [Placing another piece of paper in.] So that you now see that *other* forms of matter besides solids and liquids tend to fall to the earth; and, therefore, you will now accept from me the fact that *all* things gravitate, whatever may be their form or condition. Now *here* is another chemical test which is very rapid. [Some of the carbonic acid was poured from one vessel into another, and its presence in the latter shown by introducing into it a lighted taper, which was immediately extinguished.] You see from this also that it gravitates. All these experiments show you that, tried by the balance, tried by pouring it like water from one vessel to another, this steam, or vapour, or gas, is attracted to the earth just like other things.

Now there is another point that I want to draw your attention to. I have here a quantity of shot; each one of these falls separately, and each has its own gravitating power, as you perceive when I let them fall loosely on a sheet of paper. Now if I put them into a bottle I collect them together as one mass, and philosophers have discovered that there is a certain point in the middle of the whole collection of shots that may be considered as the *one point* in which all their gravitating power is centred, and that point they call the *centre of gravity*; it is not at all a bad name, and rather a short one—the centre of gravity. Now suppose I take a sheet of pasteboard, or any other thing easily dealt with, and suppose I run a bradawl through it at one corner A (*fig.* 3.) and Mr. Anderson holds that up in his hand before us, and I then take a piece of thread and an ivory ball, and hang that upon the awl, then the centre of gravity of both the pasteboard and the ball and string are as near as they can get to the centre of the earth; that is to say, the whole of the attracting power of the earth is, as it were, centred in a single point of the cardboard; and this point is exactly below the point of suspension. All I have to do, therefore, is to draw a line A B, corresponding with the string, and we shall find that the centre of gravity is somewhere in that line. But where? To find that out all we have to do is to take another place for the awl (*fig.* 4.), hang the plumb-line, and make the same experiment,

Fig. 3.

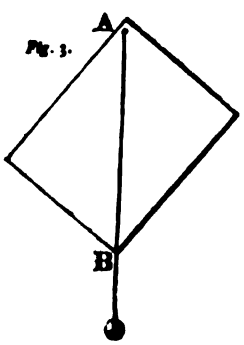
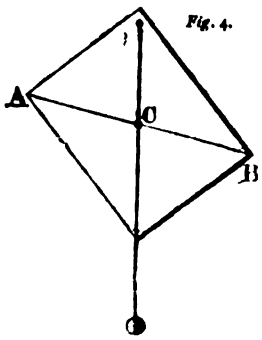


Fig. 4.



and there [at the point C] is the centre of gravity—there where the two lines which I have traced cross each other; and if I take that pasteboard, and make a hole with the bradawl through it at that point, you will see that it will be supported in any position in which it may be placed. Now, knowing that, what do I do when I try to stand upon one leg. Do you not see that I push myself over to the left side, and quietly take up the right leg, and thus bring some central point in my body over this left leg. What is that point which I throw over? You will know at once that it is the *centre of gravity*—that point in me in which the whole gravitating force of my body is centred, and which I thus bring in a line over my foot.

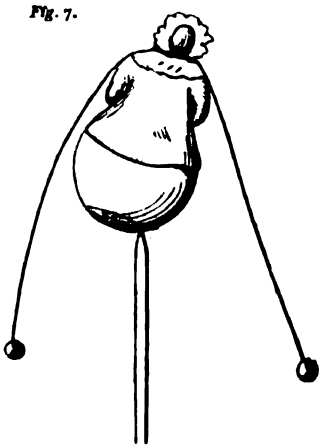
Now I have here a toy, which I happened to see the other day, and I think it will serve to illustrate our subject very well. That toy ought to lie something in this manner (*fig.* 5.). And

Fig. 5.

Fig. 6.

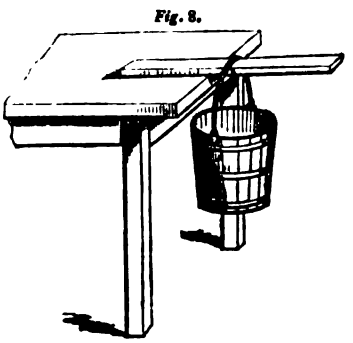
it would do so if it were uniform in substance; but you see it does not, it will get up again. And now philosophy comes to our aid; and I am perfectly sure, without looking inside the figure, that there is some arrangement there by which the centre of gravity is at the lowest point when the image is standing upright; and we may be certain when I am tilting it over (see *fig.* 6.) that I am lifting up the centre of gravity, and raising it from the earth. All this is effected by putting a piece of lead inside the lower part of the image, and making the base of large curvature, and there you have the whole secret. But what will happen if I try to make the figure stand upon a sharp point? You observe I must get that point *exactly* under the centre of gravity or it will fall over thus [endeavouring unsuccessfully to balance it]; and this you see is a difficult matter, I cannot make it stand steadily; but if I embarrass this poor old lady with a world of trouble, and hang this wire with bullets at each end about her neck, you see that it is very evident that owing to there being those two balls of lead hanging down on each side, in addition to the lead inside, I have lowered the centre of gravity, and now she will stand upon this point (*fig.* 7.); and, what is more she proves the truth of our philosophy by standing sideways.

Fig. 7.



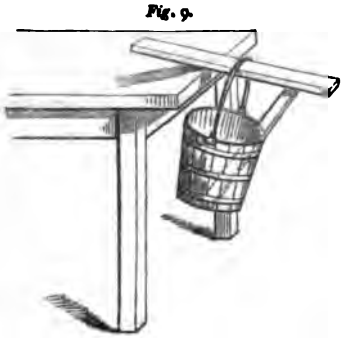
I remember an experiment which puzzled me very much when a boy. I read it in a conjuring book, and this was how the problem was put to us: "How," as the book said, "how to hang a pail of water, by means of a stick, upon the side of a table." Now I have here a table, a piece of stick, and a pail, (*fig.* 8.), and the proposition is how can that pail be hung to the edge of this table? It is to be done, and can you at all anticipate what arrangement I shall make to enable me to succeed? Why this. I take a stick, and put it in the pail between the bottom and the horizontal piece of wood, and thus give it a stiff handle, and there it is; and what is more, the more water I put into the pail the better it will hang. It is very true that before I quite succeeded I had the misfortune to push the bottoms of several pails

Fig. 8.



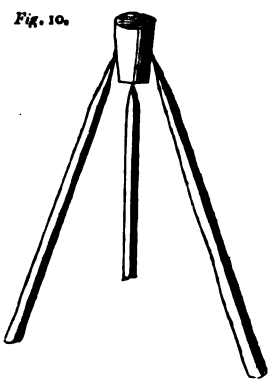
out; but here it is hanging firmly (*fig.* 9.), and you now see how you can hang up the pail in the way which the conjuring books require.

Fig. 9.



Again, if you are really so inclined (and I do hope all of you are), you will find a great deal of philosophy in this [holding up a cork and a pointed thin stick about a foot long]. Do not refer to your toy-books and say you have seen that before. Answer me rather, if I ask you, have you *understood* it before. It is an experiment which used to seem very wonderful to me when I was a boy; I used to take a piece of cork (and I remember, I thought at first that it was very important that it should be cut out in the shape of a man, but by degrees I got rid of that idea), and the problem was to balance it on the point of a stick. Why, you see I only have to stick two sharp-pointed sticks on each side, and give it wings, thus, and there you will find this beautiful condition fulfilled.

Fig. 10.



I want now to bring you to another point — all bodies, whether heavy or light, fall to the earth by this force which we call gravity. By observation moreover we see that bodies do not occupy the same time in falling: I think you will be able to see that this piece of paper and that ivory ball fall with different velocities to the table [dropping them]; and if again I take a feather and an ivory ball, and let them fall, you see they reach the table or earth at different times; that is to say, the ball falls faster than the feather. Now, that should not be so, for all bodies do fall equally fast to the earth. There are one or two beautiful points included in that statement. First of all it is manifest that an ounce, or a pound, or a ton, or a thousand tons, all fall equally fast, no one faster than another: here are two balls of lead, a very light one and a very heavy one, and you perceive they both fall to the earth in the same time. Now if I were to put into a little bag a number of these balls sufficient to make up a bulk equal to the large one, they would also fall in the same time; for if an avalanche falls, the rocks and mountains, snow and ice, together falling towards the earth, fall with the same velocity, whatever be their size.

I cannot take a better illustration of this than that of gold leaf, because it brings before us the reason of this apparent difference in the time of the fall. Here is a piece of gold leaf. Now if I take a lump of gold and this gold leaf, and let them fall through the air together, you see that the lump of gold — the sovereign, or coin — will fall much faster than the gold leaf. But why? They are both gold, whether sovereign or gold leaf. Why should they not fall to the earth with the same quickness? *They would do so*, but that the air around our globe interferes very much where we have the piece of gold so extended and enlarged as to offer much obstruction on falling through it. I will, however, show you that gold leaf *does* fall as fast when the resistance of the air is excluded—for if I take a piece of gold leaf and hang it in the centre of a bottle, so that the gold, and the bottle, and the air within shall all have an equal chance of falling, then the gold leaf will fall as fast as anything else. And if I suspend the bottle containing the gold leaf to a string, and set it oscillating like a pendulum, I may make it vibrate as hard as I please, and the gold leaf will not be disturbed, but will swing as steadily as a piece of iron would do; and I might even swing it round my head with any degree of force and it would remain undisturbed. Or, I can try another kind of experiment:—if I raise the gold leaf in this way [pulling the bottle up to the ceiling of the theatre by means of a cord and pulley, and then suddenly letting it fall to within a few inches of the lecture table], and allow it then to fall from the ceiling downwards (I will put something beneath to catch it supposing I should be *maladroit*), you will perceive that the gold leaf is not in the least disturbed. The resistance of the air having been avoided, the glass bottle and gold leaf all fall in exactly the same time.

Here is another illustration:—I have hung a piece of gold leaf in the upper part of this long glass vessel, and I have the means, by a little arrangement at the top, of letting the gold leaf loose. Before we let it loose we will remove the air by means of an air pump, and while that is being done, let me show you another experiment of the same kind. Take a penny piece, or a half crown, and a round piece of paper a trifle smaller in diameter than the coin, and try them side by side to see whether they fall at the same time [dropping them]. You see they do not —the penny piece goes down first. But, now place this paper flat on the top of the coin, so that it shall not meet with any resistance from the air, and upon *then* dropping them you see they *do* both fall in the same time [exhibiting the effect]. I dare say if I were to put this piece of gold leaf, instead of the paper, on the coin it would do as well. It is very difficult to lay the gold leaf so flat that the air shall not get under it and lift it up in falling, and I am rather doubtful as to the success of this, because the gold leaf is puckery; but I will risk the experiment. There they go together! [letting them fall], and you see at once that they both reach the table at the same moment.

We have now the air pumped out of the vessel, and you will perceive that the gold leaf will fall as quickly in this vacuum as the coin does in the air. I am now going to let it loose, and you must be quick to see how rapidly it falls. There! [letting the gold loose] there it is, falling as gold should fall.

I am sorry to see our time for parting is drawing so near. As I proceed I mean to put upon the board behind me certain words so as to recall to your minds what we have already examined; and I put the word Forces above all, and I will then add beneath the names of the special forces in the order in which we consider them; and although I fear that I have not sufficiently pointed out to you the more important circumstances connected with this force of Gravitation, especially the law which governs its attraction (for which, I think, I must take up a little time at our next meeting), still I will put that word on the board, and I hope you will now remember that we have in some degree considered the *force of gravitation*—that force which causes all bodies to attract each other when they are at sensible distances apart, and tends to draw them together.

(*The second Lecture, on* Gravitation *and* Cohesion, *will be given next Week.*)

NOTICES OF BOOKS, PATENTS, &c.

The Manufacture of Photogenic or Hydrocarbon Oils, from Coal and other Bituminous substances capable of supplying burning fluids, by Thomas Antisell, M.D., Professor of Chemistry in the Medical Department of Georgetown College, D.C., &c. &c. New York: D. Appleton & Co. 346 & 348 Broadway; London: 16 Little Britain. 1859.

It is seldom, indeed, that a work appears on any subject more opportunely than this. At the present moment, when the chief part of the globe is being ransacked to find bitumen, shales, and coals capable of yielding illuminating oils, when patents without number are being taken out, and schemes equally innumerable are being devised for obtaining and purifying them; at the present moment, we repeat, the work before us becomes invaluable. We feel this so strongly, that we believe there are many of our readers who will thank us for quoting the headings of the various chapters:—

I. Introduction — History of the Art.
II. On the Chemical Composition of Bituminous Coal, Bituminous Schist, Native Bitumens, Peat, and Organic Substances yielding Photogenic Oils.
III. On the General Principles involved in Destructive Distillation: resulting products obtained.
IV. On the products derived from the Distillation of Bituminous Coal.
V. On the products derived from the Distillation of Schists and Natural Bitumens.
VI. On the Distillation of Peat and Wood.

VII. On the various modes of applying heat in the process of distilling Photogenic Oils.

VIII. General Remarks on the Commercial Manufacture. — Synoptical *résumé* of patented improvements having reference to the Distillation of Oils from Coals, Bitumens, and Schists.

1. American Patents.
2. European Patents.

From the above table of contents, it is evident that the work before us contains information to be found in no other. The author is therefore justified in stating his treatise to be the first monograph published on the art of distilling oils from minerals containing bitumen.

The historical introduction is exceedingly interesting. It seems that the production of oils from coal was first observed during the first half of the eighteenth century.

"The discovery of the production of oils from coal appears to date as far back as the time of Boyle, when the experiments of Dr. Clayton were made upon the inflammable nature of the distillates of coal. These were first communicated to the public by the Royal Society of London many years after, in 1739. 'First,' says he, 'there came over a flegm, *then a black oil*, and then likewise a spirit (gas) arose, which I could in no wise condense.' This gas was such a matter of novelty and interest, that the appearance or nature of the oil was overlooked; and Clayton's experiments were wholly directed to the examination of the gas, and not of the fluid products."

Our author, a little further on, attributes the discovery of naphthaline to Reichenbach; this is an error, naphthaline was, unless we greatly err, first noticed some years before that date, by an English chemist named Garden. The latter extracted his substance from coal tar.

It is said that the celebrated Dr. Hope of Edinburgh, in concluding his lecture on products of destructive distillation, used to say: "Dr. Reichenbach, gentlemen, has also discovered in wood tar a number of substances, such as kreosote, piccamar, paraffine, cedriret, capnomore, and a host of others, but of no interest or importance whatsoever." If Dr. Hope were now alive, he would be one of the first to admit the great chemical principle, that the substances at one time the rarest and most difficult to prepare, are at another among the commonest and most useful.

The important observation (first made known by Reichenbach, but first practically worked out by James Young), that bituminous coal on distillation yields paraffine oil, has led to much litigation and controversy. On this subject our author has the following remarks: —

"An impression has taken hold of the American manufacturing public that the patent of James Young has no force, as it was not a new invention at the date of the patent; and from the unfavourable effect of that patent upon the actual manufacture of coal oils in this country, an ill-feeling has been produced against it. That the owners of this patent have not acted wisely by withholding sales and licences under it until very lately is to be regretted; but that it was a *bonâ fide* improvement in an art at the time when it was patented, and that therefore the patent was rightly issued in this country, there can be no shadow of doubt in the mind of anyone who carefully traces the steps of the discovery of the production of photogenic oils from different materials."

Further, with reference to Mr. Young's claims, and his successful production from coal of oils resembling those from bitumen, we have,

"This Mr. Young accomplished, and thereby is entitled to the merit of producing oils from coal by distillation, so as to establish a branch of industry; and this discovery of the value of coal is accorded to him by Reichenbach himself."

Apropos of James Young, there is an excellent account of Boghead coal and its products. He is, however, scarcely correct in the saying that

"When distilled, the Boghead coal yields several products, among which the absence of benzine is remarkable, it being present in but small quantities in the first distillation."

It is true that Boghead naphtha does not contain a very large quantity of benzole, but it is not by any means absent from the first distillation. In fact, the proportion is considerable, but it is mixed with so much of the homologues of olefiant gas and the alcohol radicals, that it does not show itself so plainly as in the distillate from ordinary coal tar.

Our author is always to be depended on as long as he confines himself to practical processes and accounts of inventions, but he is at sea at once when he attempts to grapple with chemical formulæ or abstract science. He quotes with equal confidence the results obtained twenty-five years ago and those of to-day. He is also easily led away by those apparently simple relations which some chemists delight in tracing between substances, which in reality are by no means sufficiently understood to allow of any theories being erected upon their resemblance to other bodies.

For example, he quotes the following passage, evidently regarding it as sound reasoning: —

"The solid bitumen of the Dead Sea and that of the Tar Lake of Trinidad, as well as the viscid varieties of that island, as also of many other parts, as at Bechelbronn, in France, &c. are apparently produced from the oxidation of petroleum, and their composition is exhibited in the following formulæ:—

Naphtha or petroleum, $C_{20}H_{16}$, or $C_{40}H_{32}$.
Asphalt or bitumen, $C_{40}H_{32}O$.

which manifests this derivation in a striking manner."—*Muspratt.*

Now the formula of naphtha or petroleum is not $C_{20}H_{16}$ or $C_{40}H_{32}$. It is in fact an excessively complicated mixture of hydrocarbons, some of which, by the way, are so difficult of oxidation, that their conversion into asphalt by any ordinary reaction is absurd and impossible. Moreover naphtha or petroleum consists of liquid hydrocarbons, which it would need unlimited faith to believe would yield asphalt by oxidation. Moreover, there is no guarantee whatever for $C_{40}H_{32}O$ being the formula for asphalt. It is true that its analysis may have yielded numbers agreeing with a formula, but to analyse a complex mixture, and giving the numbers which appear to agree with that analysis as being a formula, is as absurd as the proceeding of the chemist, who determining to humbly imitate Frankenstein, commenced his researches into the nature of animal bodies by making a combustion of a mouse, dried for the purpose at 212°, and carefully pulverised to ensure complete mixture.

Again, at p. 34, speaking of the products of the distillation of Rangoon tar, upon the examination of which MM. De la Rue and Müller have been engaged for some years, we have: —

"The liquid having the lowest specific gravity, and which comes out first by distillation, is an analogue of benzine, and has been termed *Sherwoodole*; it has analogous properties in dissolving grease, &c. It may be eliminated, as well as some benzole, which also forms, by nitric acid."

This unhappy paragraph is a mass of absurdities. In the first place, what are we to say of chemistry if its professors call Sherwoodole an analogue of benzole, because, like the latter, it dissolves grease! The truth is that the liquid absurdly called "Sherwoodole," is not in any way an analogue of benzole, but a mixture of benzole and its homologues with propyle, butyle, and other homologues of methyle. There are also present some substances with which we are not, as yet, sufficiently acquainted to speak more specifically. What *does* our author mean in the next sentence by saying, "it," (Sherwoodole) "may be eliminated as well as some benzole, which also forms, by nitric acid." Who ever "eliminated" benzole or "Sherwoodole," by nitric acid? Does he, by first speaking of "benzine," and then of "benzole," in almost the same paragraph, imagine them to be two different bodies? What does he mean by "which also forms"? indeed, does he mean anything?

It is really painful to see a useful book deformed in this manner.

Chapter iv. offers a great contrast to that we have just criticised. There is much information in it of a kind which must be invaluable to those who are engaged in distilling coals for photogenic purposes. The yield per ton of coke

tar, ammonial liquor and gas, are all clearly stated. The products of the distillation of the tar are also given in photogen, solar oil, ammonia, paraffine, &c.

Immediately after all this invaluable information come some scientific details connected with the constituents of coal tar, and, as usual, our author is at sea directly. Dr. Antisell is afflicted with original ideas on chemical orthography. He sometimes uses and sometimes avoids the *e* final, without any rule whatever. Thus we have in the same table picoline and parvolin, benzin and toluene. At pages 52 and 53 we repeatedly have the word paraffin, but at p. 56 it is paraffine. Quinoline (chinoline) our author writes quinoleine, pyridine he writes pyrrhedine, for pyrène, he substitutes pyrrhene. At pp. 70 and 71, he spells them correctly. According to Dr. Antisell, toluene and cumene are "highly fluorescent." This is erroneous.

We are told at p. 64 that carbolic acid "may be supposed to be formed from benzole, $C_{12}H_6$, by the addition of two equivalents of oxygen." This is equally successful with the author's theorising generally.

At p. 65 we are told that

"The heavy oil contains a singular organic product, first discovered by Dr. Hofmann, of London, and called by him 'kyanol,' or 'aniline,' which possesses the property of giving, with bleaching powder, nitric acid, and other reagents, a magnificent blue colour."

Until now, we always fancied that aniline was first formed from indigo by Fritzsche, and named by him from "anil," an Indian word for the indigo plant. We write from memory, and are unable at the present moment to refer to our library, but we also believe that Runge was the first to find aniline in coal tar, and that *he* called it "kyanol." Every one knows or ought to know, the superb researches of Hofmann on aniline, and that he has done far more for its history and that of organic alkaloids generally than any other chemist. He would be the first to repudiate the *discovery* of the base in question.

There is an absurd blunder also at p. 69. To explain it, it must be premised that at p. 27, Greville Williams's researches on the production of the alcohol radicals or isomeric bodies, from Boghead coal, are mentioned; the boiling points and specific gravities, &c. being given in a table. Now at p. 69 Williams's results are again quoted, but the products are stated to be obtained by distilling paraffine, and the investigation is attributed to Dr. Anderson. How the author fell into this error is not easy to see. Moreover, paraffine when pure distils almost entirely without decomposition.

Chapter v., although not absolutely free from error, is exceedingly valuable, because it contains a mass of information upon the yield of oils, &c. from a great number of shales, bitumens, and asphalts.

Chapter vi. is also useful, and generally very correct.

Chapter vii. is on "methods of applying heat." Here the author is at home with his work, and the information is of a most practical and important kind. We will quote the following as a sample of what the author can do:—

"Paraffin is not produced in tars of gasworks where a high cherry-red heat has been used; it is naphthaline which is the waxy solid found. At low-red heats it begins to be produced; while paraffine is evolved at temperatures beginning at 350°, and running up to a very low-red heat, not visible in the day-time. This, then, is the range of temperature within which the manufacture must be conducted. Pouillet has given the following table of temperatures, which will serve as an index to the proper understanding of this subject:—

Incipient redness	525°
Dull redness	700°
Cherry-red, commencing	800°
„ brighter	900°
„ full	1000°
Dark yellow-red	1100°
Bright ignition	1200°
White heat	1400°
Dazzling white heat	1600°

The range desirable for manufacturing gas lies between 800° and 1000°. That for the manufacture of oils terminates where that of gas manufacture begins; and perhaps the most efficient temperature is that which does not exceed 700°."

In this chapter there is a vast amount of information upon the form and materials of the retorts, &c. for distilling coals, shales, &c.

Chapter viii. is equally practical and useful. We have numerous processes for the preparation and purification of photogenic oils, we then have the American localities of manufacture, followed by a list of American and European patents.

To sum up: Dr. Antisell's work is indispensable to all who are engaged in manufacturing photogenic oils; but, as we said before, although his *practical* information is extensive and accurate, his *scientific* knowledge (at least as far as organic chemistry is concerned) is below par.

The Mineral Springs of Vichy; a Sketch of their Chemical and Physical Characters, &c. by A. B. Granville, *M.D., F.R.S., Author of the Spas of Germany, &c. &c.* Churchill: 1859.

As men condemned to good health and perpetual hard work we have often thought how pleasant it must be to be an invalid in easy circumstances: not to be very ill, not to be racked with gout, pinioned with rheumatism, or made unutterably miserable with dyspepsia; but only to have just so much no physician knows what, as to justify a man in thinking only of himself, as to call out the sympathies of good-natured friends, and before all, as to afford a reasonable excuse for an extended round of visits to those agreeable resorts of beauty, fashion, hypochondriacism, and rascality, the continental watering places. Under such circumstances, next June would certainly find us *en route* for Vichy, with Dr. Granville's book in our portmanteau. But as it is all we can concern ourselves about is the water the visitors drink and bathe in there.

Vichy is situated in the valley of the Allier, about 250 miles from Paris, and almost in the centre of France. It has been celebrated as a spa from the time of the Romans, and Dr. Granville conjectures that "*the* Cæsar may have *deposited* of the springs as he crossed the bridge over the Allier on his return from the siege of Gergovia." Since then, after passing through many vicissitudes, it has become the most popular mineral spa in France.

The geological features of the neighbourhood consist of granitic and sienitic rocks on which repose carboniferous limestone, travertine, and tufa. Through these the mineral waters surge in all directions, impregnating the entire mass of the lacustrine deposits, and forming calcareous concretions, and especially fibrous arragonite in the moveable alluvial soil.

Although, according to some authors, there are sixteen different springs in Vichy and its neighbourhood, some at a considerable distance from others, yet the chemical composition of the waters is almost identical, indicating a common origin for all. The temperature of the waters varies from 113° F. to 60° F., the difference being accounted for by the size of the streams and the distance they travel from the common source before they reach the surface.

The predominating ingredient in Vichy water is bicarbonate of soda, this salt forming 29·28 out of 38·75 grains of the solid elements which exist in 16 ounces of the water. The next is the free carbonic acid, which amounts to 15·21 cubic inches in the same quantity of water. Besides these, the water contains the sulphate, phosphate, arseniate, and borate of soda, chloride of sodium, carbonates of potash, magnesia, strontia, lime, iron, and manganese, silica, and according to some traces of iodine, bromine, lithia, and alumina. The quantity of arsenic, however, need not frighten any one from drinking Vichy water, inasmuch as the maximum quantity found has not exceeded one-thousandth part of a grain in a pint of the water.

Into the question "What are Vichy waters good for?" it is no business of ours to enter. All we can say is, that for gout and dyspepsia they would appear to be specifics. But let incautious drinkers beware. At times they are of laborious digestion and produce *un ballonnement du ventre*, which always indicates an approaching thunder-storm,—a rather inconvenient weather instrument, as Dr. Granville remarks.

"According to the estimate published by M. Bouquet, the total amount of mineral water brought to the surface by the different sources of Vichy and its neighbourhood is 62,050,000 gallons annually, which yield a produce of solid matter equal to 3,401,240 pounds in weight, of which quantity 2,244,750 pounds are carbonate of soda. This quantity of mineral water is accompanied by an escape of free carbonic acid equal to 2,279,790 pounds, representing 621,760 pounds of pure carbon.

Dr Parkins says they have never had outbreaks of epidemics at Vichy.

As an alkaline source Vichy has a superior rival in France itself, for at Val, in the Ardèche, 16 ounces of the water contain 58·24 grains of crystallised carbonate of soda.

The greater part of the water at Vichy is allowed to flow away into the Allier, but a part is evaporated down to obtain the Vichy salts, of which pastilles and some other preparations, and even confectionary, are made; the manufacture of a very fine bicarbonate of soda is also carried on. The water is concentrated by evaporation, and is then drawn off into thick earthen vessels, in which the carbonate of soda soon forms large transparent crystals. These are exposed to an atmosphere of carbonic acid, obtained from one of the natural sources, by which the crystals are converted into the bicarbonate.

Of life in Vichy Dr. Granville gives a very enticing account. The hotels are good and not dear. The visitors are free and sociable. Strauss comes with his band for a couple of months, and when he leaves in September, the visitors all depart too, and Vichy puts up its shutters until the following May.

Interesting as we have found Dr. Granville's book, we cannot help expressing a hope that when he writes again he may find time to correct his proofs. The misprints are very numerous; but with all these drawbacks the book is full of useful information for every one who is anxious to know anything of Vichy or its waters.

Improvements in dyeing cotton, wool, silk, flax, and other fibrous materials or fabrics. N. A. Grumbl, Paris, 1859.

The inventor obtains a fast black dye, and all the shades thereof, by the use of extract of logwood, bichromate of potash, and crystallised soda. The process is as follows: a bath is made by dissolving 1 pound of extract of logwood in 3½ pints of warm water. The cotton or other material is plunged into this bath, and is then wrung and dried by exposure to the atmosphere. After being thoroughly dried, it is plunged into a second bath prepared by dissolving ¾ lb. of bichromate of potash, and ¼ lb. of crystallised soda, in 3½ pints of water. After immersion in this bath, the cotton is wrung or pressed, and completed in the ordinary manner. The strength of the baths must be maintained by regular additions of the ingredients. When a fabric contains a mixture of cotton, silk, and wool, it is first plunged into a boiling bath of campeachy wood, and afterwards into a bath, at the same degree of heat, containing ¾ sulphate of copper, and ¾ bichromate of potash. Fabrics composed entirely of wool are treated in a similar manner.

Treating Straw for Paper; American Patent.

An improvement in treating straw for making a superior quality of paper has just been secured by letters patent to R. H. Collyer, and his process may be of some importance. The straw is first soaked or boiled in water to render it soft, then it is subjected to a cutting action and also to a grinding machine. This latter operation seems to be the improved feature. The straw is rubbed between grinding surfaces until every knot is crushed and made into impalpable pulp. In this finely subdivided state, the pulp is boiled in a strong caustic alkali, which dissolves all the silex (hard specks), and it is then reduced to a fine condition. The next process is that of bleaching, which is done by steeping it in solution of chloride of lime, in the usual way, the finishing steep being a weak *sour* of sulphuric acid, after which it is washed and beat up into the proper consistency, to be laid into webs in the machine.

CORRESPONDENCE.

Poisoning by Mistake.

To the Editor of the Chemical News.

Sir,—Every now and then the public are alarmed and druggists are scandalised by a case of *accidental poisoning*, or *poisoning by mistake*. A customer applying for tincture of rhubarb is served with tincture of opium, or a black draught bottle is filled up with liquor opii, or as in the case commented on in your leader last week, some one wanting chrome yellow is sold orpiment, or some other unaccountable blunder is made, which sometimes ends in the death of the customer and the ruin of the druggist. It may seem impertinent in me, but yet as having had a large establishment for many years without a case of the kind I have mentioned having happened to me, I feel inclined to give my fellow druggists a few words of advice on the arrangement of our bottles on the shelves. My remarks will not apply to the dispensing department, for it must be allowed that few accidents happen in that. It is in the retail that these dreadful blunders usually occur, and it seems to me that it must happen in consequence of poisonous remedies being kept in the same sized bottles, and in close proximity to other medicines of a similar appearance which are not poisonous. Now this is what I endeavour to avoid in the arrangement of my shelves. I keep tinct. opii in a smaller bottle, and on another shelf than tict. rhei. The trouble of filling once or twice oftener is quite compensated for by safety ensured. Another mistake made recently was selling sulphate of zinc for sulphate of magnesia. This perhaps occurred from a bad system of labelling, of which I have complained in other places. I always had the *principal* word written at as great a length as possible—zinci s. magnes s. for instance. Neither salt is likely to be mistaken for another salt of the same base; but if half or more than half the label was taken up by sulph. or sulphas, it is possible that that word only might be seen, and as the salts do somewhat resemble one another, the one might be taken for the other. But this could never happen except with criminal carelessness, if bottles were labelled as I suggest. I might write a good deal more to the same purpose, but I am sure I should only be writing thoughts which have at times occurred to every one of my fellow druggists who have thought on the subject.

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Chemical Notices from foreign sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

Phenomena of Oxidation.—We have another long paper by M. Kuhlmann [1] on certain phenomena of oxidation by means of oxides of iron, manganese, and various salts. These phenomena of oxidation by the influence of a *third* substance, have been already explained by the writer of this article in his memoir "*Sur la Force Catalytique, &c.*" to which the *So-*

[1] *Comptes-Rendus*, Dec. 19, 1859.

ciété Hollandaise des Sciences, of Haarlem, awarded its gold medal in 1858. If M. Kuhlmann imagines he has brought out a new theory he is mistaken; many examples of oxidation by the influence of a third body were mentioned in the memoir just cited and reported to the combustion of hydrogen by oxygen under the influence of platinum.

Nor are the facts exposed by M. Kuhlman essentially new. Thus M. Chevreul was the first to notice that sulphate of lime gave oxygen to putrescent matter, and became sulphide of calcium. Liebig, in the introduction to his *Organic Chemistry* has mentioned the fact of iron pyrites found crystallised in cubes upon the decayed roots of trees which have remained for some time in water containing a small quantity of sulphate of iron.

On the production of rust upon a piece of iron, M. Kuhlmann says: "As soon as a spot of rust is formed upon the iron the metal is successively eaten away, because those parts which are immediately in contact with the rust are oxidised at the expense of its oxygen; afterwards the rust takes back from the air the oxygen it has lost," and so the oxidation continues. But we should like to be told how the *spot* of rust is formed in the first instance! M. Hervé-Mangon[2] explains the part played by peroxide of iron in nature[3] rather differently. According to the author this peroxide is not immediately reduced to protoxide by the organic matter in the soil, but combines with a certain acid (which he supposes to be the *crenic acid* of Berzelius) to form an *insoluble* salt of peroxide of iron. This salt when not exposed to the air passes to the state of protosalt, *i. e.* the acid it contains reduces the peroxide of iron to protoxide, and the new protoxide salt formed is *soluble* in water. If a drainage tube obstructed with an insoluble ochreous deposit, be filled with water and closed at both ends, the insoluble salt of peroxide of iron which forms the ochreous deposit disappears, is replaced by a soluble protoxide salt, which can easily be washed out of the tube. And when the protoxide salt in question is in contact with the atmosphere, the ochreous deposit is formed anew.

Decomposition of Sulphate of Zinc.—M. Persoz[4] starting from the formula: $ZnO,SO_3 + NaCl = NaO,SO_3 + ZnCl$, imagined that by heating a mixture of sulphate of zinc and chloride of sodium, he would be able to obtain chloride of zinc which, either anhydrous or in solution, is susceptible of many useful applications in the arts, &c. But he finds it far better to employ a mixture of one equivalent of sulphate of zinc, and one equivalent of *chloride of calcium*, because the volatility of the chloride of zinc and the infusibility of the sulphate of lime formed render the double decomposition more efficacious. The chloride formed is not altogether volatilised; ¼th, or thereabouts, remains in the retort with the sulphate of lime, but can be easily extracted by water, so that by this method the whole of the sulphate of zinc can be transformed into chloride, and thus may be utilised the large quantities of sulphate of zinc produced every year in galvanic piles.

Analysis of Boracite.—H. Rose found in 1858 that boracite contains chlorine as an essential element in its composition; the same fact had been already made known by M. Ludwig for Stassfurtite (a mineral from Stassfurth), and confirmed anew by M. Heintz, who established for the last named mineral the formula:

$$2(3MgO.\ 4BO_3) + MgCl,\ HO.$$

M. Potyka has more recently examined these two minerals. When both washed until the water which passes no longer precipitates with nitrate of silver, or with chloride of barium, and then dried at 100° (Centigrade), they give the following composition:—

	Boracite.	Stassfurtite.
Chlorine	8·15	8·02
Magnesium	2·75	2·71
Magnesia	25·24	26·15
Protoxide of iron	1·59	0·40
Boracic acid	62·91	60·75 (by difference)
Water	0·55	1·95
	101·19	99·98

The formula deduced from these numbers for boracite is:

$$2(3MgO.\ 4BO_3) + MgCl.$$

It only differs from Stassfurtite then by 1 equivalent of water.

II. ORGANIC CHEMISTRY.

Action of Baryta on Suberic Acid.—M. Alfred Riche has shown[6] that when suberic acid is heated with an excess of bayrta, a peculiar carburetted hydrogen distils. This substance boils at + 76° + (Centigrade), its analysis leads to the formula $C_{12}H_{14}$, corresponding to four volumes of vapour. Its formation may be thus explained:

$$C_{16}H_{12}O_6,\ 2HO + 4BaO = C_{12}H_{14} + 4(BaO.CO_2)$$

Suberic acid + baryta = hydrocarbon + carbonate of baryta.

This new hydrocarbon is insoluble in water, soluble in alcohol and ether. Its odour is rather aromatic, it takes fire easily and burns with a bright flame bordered with blue. The author has not yet decided where this new substance must be classed.

Butyric Acid.—Butyric acid is formed in a great number of circumstances,—in rancid butter, by the prolonged fermentation of starch, sugar, &c. M. Pelouze has found it in the excrements of man; it has been also recognised in sour soup and broth, and it is probably to butyric acid that is owing the nauseous taste of decomposed fruits, such as strawberries, &c. In this case the fruit has a taste of bad butter.

M. Isidore Pierre formerly demonstrated the presence of butyric acid in bad cider, which had occasioned various accidents to those who drank it. The same savant[7] has lately shown that this acid is likewise present in the fermented juice of frozen beetroot. This beetroot was on a heap of manure, which, together with a little flood of water that was close by likewise contained butyric acid. This water having been drunk by some horses occasioned illness. The butyric acid was found in these cases combined as a salt. M. Pierre's researches took place at Caen; he affirms, however, that MM. Verdiel and Risler have found found butyric acid in manure and in the soil of the Agronomical Institute of Versailles.

Essence of Cloves.—Professor Boettger[8] has made the following curious observations. When dry oxide of silver is damped with essence of cloves, the mixture takes fire spontaneously and the oxide is reduced to the metallic state. The same takes place with peroxide of silver obtained by electricity, and with oxide of gold. With peroxide of lead and chloride of lime the essence becomes heated and evolves smoke. It has no action upon permanganate of potash or on oxide of mercury. The hydrocarbon oils that this essence contains when separated from the eugenic acid it also contains, do not act upon the above substances in the same intense manner.

III. CHEMICAL ANALYSIS.

Determination of Nitrogen by Volume.—In organic analysis when nitrogen is determined by volume, any substance in the combustion tube capable of reducing carbonic acid to oxide of carbon becomes at once a source of error. It has been asked lately, whether the copper which in these determinations is placed in the fore part of the tube is not capable of reducing carbonic acid. M. Limpricht having announced that such was indeed the case, that carbonic oxide was pro-

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[2] *Comptes-Rendus*, Août 1859.
[3] See M. Kuhlmann's first paper in CHEMICAL NEWS, vol. i. No. 2, Dec. 17, 1859.
[4] *Cosmos*, Nov. 1859.
[5] *Pogg. Ann.* cvii. p. 433.
[6] *Comptes-Rendus*, Août 1859.
[7] *Comptes-Rendus*, xlix. p. 286.
[8] *Journ. für Praktische Chemie*, xxxvi. p. 241.

duced at a dark red heat, thereby throwing a doubt upon the exactness of nitrogen determinations by this method, M. Perrot undertook some experiments[9], and showed that copper reduced by hydrogen, as employed by M. Limpricht, had no reductive action upon carbonic acid, but that if a very slight quantity of brass were present, or iron, the carbonic acid is reduced easily. The copper used in M. Perrot's experiments, was obtained by roasting copper turnings, and then reducing them by hydrogen.

M. Schrötter[10] has made the following experiments upon the same subject.

1. Small bands of pure copper, obtained by rolling out copper wire, do not decompose carbonic acid at a red heat.

2. Copper turnings roasted and then reduced by hydrogen do not decompose carbonic acid at a red heat, if the hydrogen has been thoroughly expelled by a current of cold air.

3. Copper, obtained by reducing copper oxide, reduces carbonic acid at a red heat.

M. Schrötter supposes, therefore, that in M. Limpricht's experiments hydrogen was present in the copper employed. M. Perrot is of opinion that M. Limpricht's copper contained a little iron or zinc. However that may be, the experiments alluded to show us how very particular we should be, in nitrogen determinations by volume, that the copper employed be chemically pure.

SCIENTIFIC NOTES AND QUERIES.

Specific Gravity as a Test of the value of Gold Alloys.—Sir,—Having lately turned my attention to estimating the amount of gold in gold chains, necklaces, &c. by means of their specific gravities, I have been stopped in the inquiry by a query, which probably some of the readers of the Chemical News can solve. It is as follows:—"Has an alloy of gold a specific gravity the mean of its constituents, and if not, how may it be obtained?" If I err not, silver, copper and zinc are all the alloys found in gold articles. Such being the case should the subject be a little more investigated, I have no doubt we shall be soon able to put buyers of jewellery in possession of a simple means of ascertaining the value of their purchases. This will certainly check in great measure the impositions which I believe are constantly going on. — *Physeos Zetetes.*

[The specific gravity of an alloy is in most cases *not* the mean of that of its constituents. The subject mentioned by our correspondent is, however, well worth investigation, as doubtless a table could be easily constructed by means of which the amount of gold in an alloy could be approximately ascertained. Ed.]

Peroxide of Manganese as a Deodorising Agent.—Sir,—In reference to Mr. Spencer's letter on the action of the oxides of iron, I have found the peroxide of manganese to be a most invaluable agent, not only in decolorising, but deodorising, water and other neutral liquids. If a more powerful deodorant or disinfectant be required its admixture with chloride of lime, in proportion of $\frac{1}{8}$ths manganese and $\frac{1}{4}$th lime, accomplishes the object much better than anything else I am acquainted with, as experiments with sulphuretted hydrogen and alkaline hydrosulphurets will prove, whilst its cheapness is at once a recommendation.—*John Horsley.*

Peroxide of Lead in Lucifer Matches.—Sir,—I shall be greatly obliged if any of your readers can inform me of a practical formula for the preparation of lucifer matches with peroxide of lead, which I see in your Chemical Notices is extensively employed in the fabrication, and also what is the advantage of its use.—*W. M.*

MISCELLANEOUS.

Sorgho Dye.—A. Winter, of Austria, has discovered a carmine-colouring matter in most parts of the Chinese sorgho, especially in the expressed stem, and has obtained a patent in Austria, Baden, and other states. The process is as follows:—The sorgho is pressed in the usual manner, and the empty cane piled up under cover in regular heaps, several feet high, and the fermentation which immediately sets in is so directed by more or less access of air as to prevent it from becoming putrid. After two weeks the whole mass is of a reddish-brown or red colour, when the fermentation is interrupted by drying. When dry, the mass is ground sufficiently fine for the extraction of the colouring matter. It is covered in the proper vessels with cold soft water, and allowed to stand for 12 hours; but little of the pigment dissolves during that time. It is then drained, and afterwards treated with a weak caustic soda or potash ley until this no longer extracts anything. This solution is carefully neutralised with sulphuric acid, thus precipitating the colouring matter in red flakes, which, after settling, is washed with water, collected on filters, and dried. This colour dissolves in alcohol, alkaline leys, dilute acids, &c. and is employed for the dyeing of silks and woollens with the common tin mordants. The colours produced from it are said to be unchanged by light or by washing with warm soapsuds.—*American Druggist's Circular.*

Analysis of Wheat Flours.

	Starch.	Gluten.	Sugar.	Dextrine or Gum.	Water.	Bran.	Fatty Matter.
Odessa flour, hard grain	56·5	14·6	8·5	4·9	12·0	2·0	—
Odessa flour, soft grain	62·0	12·0	7·5	5·3	10·0	1·2	—
English flour . .	75·5	11·0	4·7	3·3	10·0	—	—
Baker's flour . .	72·8	10·0	4·2	2·3	10·0	—	—
Recent analysis of dried flour . .	73·2	13·4	5·6	0·2	11.1	—	2·2

Gluten is composed of glutine, fibrine, albumen.

100 parts of wheat give:—

Flour for making white bread 58 } 72, sometimes 80 to 85.
" " brown " 14 }

		100 parts wheat:—	
Bran	26	Straw . . .	62
Lost	2	Grain . . .	38
	100		100

F. C. Calvert, F.R.S.

Novel Application of Aluminium.—The King of Denmark has had a helmet of aluminium made in Paris. It weighs only 700 grammes. A similar helmet made of brass would have weighed 1700 grammes.

Astringent Tincture for the Teeth.—

Tannin	2 drachms.
Spirit of wine . . .	3 oz. 6 "
Tincture of benzoin . . .	2 "
Essence of mint	½ "

Dissolve and filter. Wash the mouth with a few drops of this tincture mixed with water three or four times a day.—*Art Dentaire.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Phos.—See work reviewed in present number.

A. W. W.—It is difficult to advise our correspondent; but probably the laboratory of the Pharmaceutical Society or the Birkbeck laboratory at University College.

L. & R.—Iron is tinned by dipping clean plates of iron into a bath of melted tin.

Laybourn.—1. About two years. 2. At the best operative chemists.

W. M.—Try red sulphuret of antimony in the place of vermilion.

R. M. A.—May be had of all wholesale druggists.

A. T. B.—An article is under consideration, and may perhaps be given in a future number.

Ignoramus — *R. C. P.* — *H. N. D.* — *A Subscriber* — *J. G. F.* — *R.* — received.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

[9] *Comptes-Rendus*, Jan. 1859.

[10] *Sitzungsberichte der Acad. zu Wien*, xxiv. p. 27.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Various Methods for the Estimation of Copper, by FREDERICK FIELD.

[SECOND PART.]

IN resuming the brief notice upon the various methods of estimating copper, it may be remarked that Dr. Mohr (*Liebig's Annalen*, May 1855, and *Chemical Gazette*, July 1855), in a paper upon the volumetric determination of hydrocyanic acid and the cyanides of the alkaline metals, recommends a solution of a copper salt added to the liquid to be tested containing excess of ammonia. The cupreous compound is added until a permanent blue colour is produced. He explains the theory as follows:

$$2\,NH_4Cy + CuO.SO_3 + xNH_4O = CuCy.NH_4Cy + NH_4O.SO_3 + xNH_4O.$$

"There are, therefore," he says, "two atoms of cyanogen and one of copper in the compound. All the experiments prove the existence of the compound $CuCy + NH_4Cy$, and show that no intermediate forms are produced in the process." That Dr. Mohr is correct in asserting the existence of $CuCy + NH_4Cy$, there can be little doubt, although I believe he has not succeeded in separating it from its solution. Many experiments I made some years ago convince me that a solution of a copper salt is a very delicate test for cyanogen, and that the strength of all alkaline cyanides and solutions of hydrocyanic acid can be most readily determined, and with the greatest exactness by this means, but the concluding portion of the paragraph quoted above, in which is said, "that no intermediate forms are produced in the process," is open to discussion. When cyanide of potassium or hydrocyanic acid is added to a strong solution of an ammoniacal salt of copper, green crystals of great beauty are deposited, only soluble after some time in cold ammonia. This has often happened in an assay of rich copper ore, when the solution was not sufficiently dilute, and caused much trouble, as the crystals settle quickly and adhere slightly to the glass — this compound has been analysed by Dufau, who gives the composition

$$2\,NH_3.Cu_2Cy.CuCy.$$

(Cyanide cuproso-cupric bi-ammoniacal), and more recently by Hilkenkamp, whose analysis leads to following formula:—

$$2\,NH_3.\,2\,Cu_2Cy.\,CuCy.\,+\,2\,HO.$$

varying considerably from the results obtained by Dufau. After separating the crystals by filtration, the mother-liquid deposits brilliant violet crystalline scales of great lustre, which consists of $2NH_3 2Cu_2Cy.CuCy$ or the green compound minus two equivalents[1] of water (Hilkenkamp).

Besides these two compounds, I have met with others which I believe have not been noticed. The solution from which the green and violet crystals have separated, is of a pale blue colour, and deposits after some days hard golden coloured crystals of considerable size and beauty.

Also when hydrocyanic acid, or a soluble cyanide is added in slight excess to an ammoniacal solution of copper, so as to render it colourless, brilliant pearly crystals, some exceeding an inch in length, are deposited after the lapse of a few weeks. This compound contains much less copper than that described by Mohr. It may be further added that when cyanide of potassium is mixed in slight excess with ammoniacal copper containing a large quantity of sesquioxide of iron or other insoluble substance, in suspension, small white feathery tufts form on the surface of the precipitate, after a few hours. These crystals are very soluble in water, and bear every resemblance to cupro-cyanide of ammonium ($Cu_2Cy.NH_4Cy$). All the other compounds mentioned above are perfectly insoluble in cold water; thus, even omitting the white crystalline body deposited after the solution becomes colourless, and the tufty crystals just mentioned, at least three compounds, green, violet, and yellow, are formed.

Notwithstanding this, however, it is certain that *two* atoms of cyanogen are necessary to decolorise *one* of copper in ammonia; and whatever may be the formulæ of the intermediate products, they are resolved into a compound containing two of cyanogen and one of metal. Dr. Mohr mentions as a converse to the estimation of hydrocyanic acid by copper, the estimation of copper by hydrocyanic acid. That eminent chemist was probably unaware of Mr. Parkes's method published some years previously.

Appended is a table containing some results of experiments made upon pure copper, and that metal when in conjunction with some others. As this subject was treated in the last paper upon the subject, no further comment is necessary.

1000 grains of solution of cyanide of potassium exactly decolorised 10·00 copper.

						Divisions of burette in grs.
10·00	Copper			require		1000
10·00	"	+	10 grs. of	Iron	"	1000
10·00	"	+	" "	Lead	"	1000
10·00	"	+	" "	Bismuth	"	1000
10·00	"	+	" "	Antimony	"	1000
10·00	"	+	" "	Tin	"	1000
10·00	"	+	" "	Mercury	"	1500
10·00	"	+	" "	Silver	"	1320
10·00	"	+	" "	Zinc	"	1250

[1] As the separation of these two beautiful compounds is attended with some difficulty when they are both in solution in ammonia, the following method employed by Mr. John Abel and myself in some researches upon the cyanides, may be adopted with advantage. On adding a solution of cyanide of potassium to a moderately strong solution of an ammoniacal salt of copper the green compound is precipitated, perfectly free from the *violet*. On pouring off the mother-liquid into weak hydrochloric acid di-cyanide of copper is precipitated. This substance dissolved in weak warm ammonia, and filtered, gives the violet crystals free from the *green*. In attempting to obtain the former compound by gentle evaporation of the filtrate from the green crystals, a mixture of both salts nearly always occurs.—*F. Field.*

						Divisions of burette in grs.
10·00	Coopper	+	10 grs. of	Nickel	requirs . . .	1950
10·00	„	+	„ „	Cobalt	„ . . .	1120
10·00	„	+	„ „	Chromium	„ . . .	1000
10·00	„	+	„ „	Arsenic	„ . . .	1000
10·00	„	+	„ „	(Arseniate of Iron)	colour completely disguised.	
10·00	„	+	„ „	Manganese	„ . . .	880
10·00	„	+	„ „	Calcium	„ . . .	1000
10·00	„	+	„ „	Barium	„ . . .	1000
10·00	„	+	„ „	Strontium	„ . . .	1000
10·00	„	+	„ „	Aluminum	„ . . .	1000

The metals which I was unable to procure in their uncombined condition were estimated from their compounds.

Precipitation of Metallic Copper by Iron or Zinc.—The fact of this process being so well known and so frequently described would seem to render further remarks unnecessary, but to insure good results certain minutiæ must be attended to, or very grave errors are likely to occur. The method generally described is as follows:—

The substance containing copper is dissolved in nitro-hydrochloric acid, and the whole of the nitric acid expelled by evaporation and subsequent ebullition with excess of hydrochloric acid. A clean piece of iron or some fragments of pure zinc are placed in the solution until the whole of the copper is precipitated. The finely divided metal is removed from the precipitant, washed, dried at 212° and weighed.

In the first place the copper solution should not contain a great excess of hydrochloric acid, or the precipitated copper will adhere in flakes so closely to the iron as to prevent its removal. As much acid, therefore, as possible, should be driven off by evaporation, before the introduction of the iron. After all the copper is precipitated, the plate of iron removed, and the greater portion of the ferruginous solution decanted off, the addition of hot water immediately renders the remaining liquid turbid, from the formation of basic salts of iron. A few drops of hydrochloric acid dissolve these salts, and the washing and decantation may be continued. When it is considered that nearly all the iron has been got rid of (which generally happens after the fifth or sixth washing, if the precipitated copper only amount to 20 or 30 grains), a small quantity of the liquid is poured in a tube and ferrycianide of potassium added. If a blue colour is produced, of course the washing must be continued. When the copper has been proved to be free from iron it is carefully dried in the same basin in which it was precipitated, and weighed.

By far the most delicate part of the process is the washing of the copper. If too much hydrochloric acid be added, especially when the water is near the boiling point, and when the iron exists in very small quantity, a large portion of the copper is dissolved. This is particularly the case when the metal is very finely divided, and then long addition even of very weak hydrochloric acid dissolves a large amount with formation of sub-chloride. On the other hand, if no acid be employed it is impossible to remove the basic salts of iron, and much of that metal remains with the copper.

The solubility of copper in weak hydrochloric acid when the metal is finely divided, is indeed extraordinary. A moderately strong solution of subchloride of copper in hydrochloric acid can be obtained by digesting a quantity of precipitated copper with water containing ten per cent. *hydrochloric* acid for a few hours, at a temperature of about 140° Fahrenheit. Strong boiling acid has not nearly so powerful a reaction upon the metal. Although I am aware that it is always recommended to employ boiling water for the washing in this assay, I have seen such great mistakes made, involving such serious consequences, that I never have employed it myself. If water at about the temperature of 100° or 120° Fahrenheit be used, containing from one to two per cent. of hydrochloric acid, all ferruginous salts are removed, and no copper is dissolved. The operation is doubtless longer, but the object is accomplished. Many objections which have been mentioned cannot be adduced in the employment of zinc instead of iron. No basic salts are thrown down from the zinc solution by hot water, and therefore the addition of hydrochloric acid is unnecessary, a long continued washing with water being sufficient.

However carefully performed, this estimation is never *perfectly* correct. I have never examined copper precipitated either by zinc or iron without finding traces of those metals. At the same time there is always a slight loss of copper in the primary solution of the metal, filtration, and especially precipitation, during the effervescence produced by the evolution of hydrogen. In a commercial point of view, the small amount of foreign metals in the precipitated copper compensates for that loss, and it has been proved by numerous estimations that when all points of the operation have been carefully attended to, the copper obtained is not far from the truth. Pure crystallised sulphate of copper, for instance, yields within a few hundredths of a grain the calculated amount of metal.

Pelouze's Process.—The well known method first proposed by Pelouze for the estimation of copper, which consists in precipitating its sulphide by sulphide of sodium in an ammoniacal solution, although disapproved of by some chemists, appear (as far as my own experiments have gone) to be very accurate, if the precautions mentioned by the author be adhered to. The suspended oxide of iron in the solution does not interfere in any way with the success of the process, although it renders a very gradual and cautious addition of the alkaline sulphide necessary, and of course a longer time is required for the execution of the assay. The great instability of the sulphide of sodium solution, and the necessity of keeping the copper liquid at a high temperature during the precipitation, renders the process more irksome than many others which have been proposed.

Treille's Process.—In the *Comptes-Rendus* for Feb. 1858, M. Treille has given a process for the estimation of copper by permanganate of potash. The oxide of copper is dissolved in ammonia, sulphite of soda added until the solution becomes colourless; excess of sulphurous acid expelled by hydrochloric acid and ebullition, and the copper estimated by a standard solution of permanganate of potash. M. Treille remarks that the copper salts are completely reduced to the state of sub-salts by the addition of alkaline sulphites, but only in the presence of ammonia. I have not found this observation to be correct, for although it is difficult to deoxidise protosalts *completely* by sulphurous acid, in very acid solutions, the gradual addition of carbonate of soda, until a slight excess is introduced, perfectly accomplishes the deoxidation, the orange oxide being precipitated, which dissolves in hydrochloric acid with a colourless solution. It may be mentioned here that the simplest and by far the most expeditious method of converting proto- into sub-salts of copper by means of alkaline sulphites, is to mix about equal quantities of sulphite and carbonate of soda, and to make of these salts a strong cold solution. This liquid poured into a protosalt of

copper instantly decomposes it, and even in the cold, much yellow oxide is precipitated. After a few minutes boiling the whole is converted into suboxide, which dissolves in hydrochloric acid or ammonia with no shade of colour.[2]

F. Mohr's process consists in forming a potassio-tartrate of copper, precipitating with grape sugar, and dissolving the suboxide, after thorough washing, in hydrochloric acid, with the addition of chloride of sodium, by which a double chloride of copper and sodium is formed. A solution of permanganate of potash indicates the amount of copper. This method is not so simple as that of Treille, the grape sugar being difficult to wash from the suboxide. The use of chloride of sodium, and indeed, the formation of a double salt of sodium and copper in this instance is doubtful.

Schwarz obtains the suboxide in a similar manner, and dissolves it in an acid solution of perchloride of iron. Protochloride of copper is formed by the conversion of a portion of the perchloride of iron into the protochloride, and the metal in the latter salt estimated by permanganate of potash. The copper can therefore be easily determined by the amount of iron-salt deoxidised.

(To be continued.)

TECHNICAL CHEMISTRY.

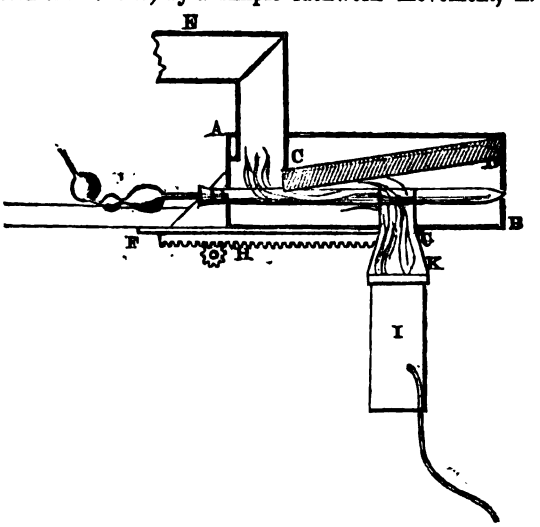
Description of a Simple Gas Combustion Furnace, by Alfred Sibson, *F.C.S., First Assistant in the Laboratory of the Royal Agricultural College, Cirencester.*

The accompanying sketch is intended to represent a new kind of combustion furnace which I devised some months ago, and have lately succeeded in perfecting. As it fully realises the expectations formed of it, and is now exclusively used (for the purposes presently to be mentioned) in our laboratory, the following description is supplied in the belief that the arrangement may possibly be of service in other laboratories.

This furnace is in no way intended to supersede, or even to compete with, Dr. Hofmann's gas-furnace, which in its latest form supplies all that can be desired for use in researches in organic chemistry. The present arrangement is suggested as a comparatively simple and inexpensive substitute for the above in cases where greater celerity and convenience are desired than can be obtained by the old method with charcoal.

The purpose for which this arrangement was devised, and for which it has proved most useful, is for making nitrogen determinations in guanos, superphosphates, or other artificial manures, for which comparatively short combustion tubes may generally be used. Some months constant use of the arrangement have proved that combustions of the above description can be made in it as completely as with charcoal, and with far greater celerity and convenience to the operator; it also allows of a more complete control over the operation than in the latter method.

The furnace is of simple construction, and can be made by any intelligent smith; it is not likely to get out of order, and consumes but little gas. Its principle will be understood if it is called a "Gas Reverberatory Furnace," a term perhaps not inappropriate, since a gas-burner corresponds to the fire of a reverberatory furnace, and its flame, after arching over, is drawn horizontally to a chimney on the same principle. The requisite extension of the fire is obtained by drawing this burner backwards from the chimney under which the front portion of the combustion tube is placed. The body of the furnace, A B, is simply a box of sheet iron of about 12 inches long, and 5 inches wide, and 4 deep, open at bottom and supported either by loops against a wall, or on legs. It is lined by a lump of fire-brick, C D, hollowed longitudinally, so as to leave an arched cavity through the furnace; the roof of this cavity is slightly lower at the chimney than at the further end; its dimensions are about 2 inches wide and 2 inches high at its highest part. The chimney C E, rises perpendicularly near the front end of the cavity above mentioned, and opens on a level with its roof. This chimney (also of sheet iron, about 2 inches diameter) must be connected with the flue of some furnace that is daily used, so as to insure a moderate draught. It should also be furnished with a damper to regulate the current of air passing through it. A separate iron plate, F G, having the burner attached to one end, is made to slide over the bottom of the frame, from end to end, by a simple rackwork movement, H.



The burner I, is a common wire gauze burner of iron about 3 inches square; it slides into a pyramidal funnel K, which leads the flame up into the cavity of the furnace. On a support attached to the further and upper end of this funnel one end of the combustion tube (or tubes, the furnace we use being constructed to make two combustions at once) rests, while the other end, having the nitrogen bulb attached, rests in a hole made to receive it in the front of the furnace, where there is an iron shelf provided to receive the bulb. The gauze burner is supplied with gas by a flexible tube, furnished with a stopcock, from any adjacent gaspipe.

In using the apparatus, the burner is drawn up close under the chimney, and the combustion tube, with its bulb attached, introduced by the hole above mentioned into the cavity of the frame, where it is supported on a narrow grooved slip of iron, one end of which [redacted] with the combustion tube at the front, and is [redacted] so as to prevent its being dragged by the motion of the burner.

[2] I am not aware if it has been observed by chemists that hydrated sulphite of copper (probably $Cu_2O.SO_2$, $CuO.SO_2$, xHO) is very soluble in carbonate of soda, forming a bright blue solution. When sulphate of copper, for instance, is precipitated by a strong solution of sulphite of soda, the precipitate is readily soluble in the alkaline carbonate.

A small flame is now to be lighted, so as to warm the tube gently, after which more flame is to be put on until the portion of tube exposed to it attains a good red heat; the fire is extended along the tube as the progress of the operation demands, by the means above mentioned, which allows of a very gradual extension of the heat, and the gas increased from time to time, so as to keep the tube well covered with flame. At the conclusion of the combustion, the draught may be increased and a large flame put on for a few minutes, which, wrapping round the tubes, heats them sufficiently to expel every trace of volatile matter. The gas is now turned off, and all subsequent operations performed as usual.

PHARMACY, TOXICOLOGY, &c.

On the Therapeutic Value of Medicinal Plants grown under certain conditions, by H. A. Tilden.

The American Pharmaceutical Association last year assigned to Mr. H. A. Tilden the question relating to the comparative therapeutic value of foreign and indigenous or cultivated plants. Such a question necessarily involved an extended series of observations and experiments lasting over two or more seasons, and he is only able this year to make a partial report. The part we extract from the *American Journal of Materia Medica* relates to the growth of hyoscyamus with different manures, showing their influence on the development of the active principle.

Pursuant to the general plan, he caused different sections of a large field of hyoscyamus, of the second year's growth, to be watered—one with a solution of nitrate of potassa, another with a solution of nitrate of soda, and another with a solution of guano—until the plants had reached maturity or the period of full bloom.

The plants watered exhibited marked difference in vigour of growth over other portions of the field, that portion upon which nitrate of potash had been applied being of a much darker green colour than that watered with nitrate of soda, and both much greener than that watered with solution of guano. The same difference in appearance was observable in a field of the same plant of the first year's growth.

At maturity the plants were collected and submitted to an uniform process of crushing, expression, and subsequent maceration of the pulp in alcohol. The expressed juice and alcoholic solution were evaporated to a pillular consistence.

A portion of each extract was dried, and treated by strong alcohol to dissolve the chlorophyll, alkaloid, and resinous principles evaporated, and treated with hot water to separate the resin and chlorophyll. The solution in hot water was boiled with oxide of lead, to separate the colouring matter, filtered, and the filtrate evaporated to dryness, giving a nearly white substance having marked alkaline reactions. Per centage in the extracts, as follows:—

	Ordinary cultivation.	Guano.	Nitrate of potassa.	Nitrate of soda.
Impure alkaline substance . . .	20·800	23·316	24·365	25·850
Colouring matter .	14·855	12·833	12·795	13·445

The alkaline principle, heated in a tube with *potassa*, disengaged ammonia largely, showing the presence of a large amount of *nitrogen*, and indicating the presence of a vegetable alkaloid.

The precise character of this impure alkaloid, to which the plant undoubtedly, to a great extent, owes its activity as a medicinal agent, we are now unable to state: reserving this for further examination.

The disengagement of strong ammonia indicates the presence of an alkaloid, probably *hyoscyamia*, as found by Brande.

The variation of this principle in the different extracts, as shown by the table above, enables us to draw the inference, fairly, that the different methods of treatment of the plant, or cultivation, produce a marked difference in its development; and we have no doubt, from the difference in the ammoniacal odour perceptible when each are tried with potash, that the pure hyoscyamia will be found to vary in similar proportion.

The *chlorophyll* and resin were separated by dissolving the *resin* in alcohol of the specific gravity of 90°, filtered, and the filtrate evaporated to dryness.

The residuum insoluble in alcohol was treated by cold water, to determine the *starch*; the soluble portion evaporated to a syrupy consistence, and the gum and albumen precipitated by alcohol.

The colouring matter contained in the aqueous part, together with the sugar, were not determined.

The result of the examination of this portion was as follows:—

	Ordinary cultivation.	Guano.	Nitrate of potash.	Nitrate of soda.
Soluble in alcohol .	47·244	49·229	45·269	44·829
Alkaline and colouring matter . .	35·433	36·453	32·162	39·325
Resin . . .	11·811	13·076	5·405	4·281
Chlorophyll . .	—	—	2·202	1·223
Starch . . .	2·482	2·561	1·992	1·999
Gum and albumen .	5·490	6·662	6·002	9·890

Another portion of each extract was dried and incinerated; the combustion was not carried far enough to produce entire destruction of the carbon. The ashes were then treated as follows:—

The carbonic acid gas was determined, by weighing, by hydrochloric acid, in the apparatus of Will; the solution was then placed in a porcelain dish, and evaporated to dryness, then dissolved in water, acidulated with a little hydrochloric acid, and filtered—the residuum upon the filter giving carbon and silica. From the filtered liquor all lime was precipitated by oxalate of ammonia, filtered, and the lime estimated in the state of sulphate of lime. The filtered liquor was evaporated to dryness, to expel the salt of ammonia previously added, and the residuum dissolved in water. To the solution was added ammonia, which precipitated the phosphate of magnesia, oxide of iron, and alumina. These were separated from each other by the usual known process. From the filtered solution free *phosphoric acid* was precipitated by sulphate of ammonico-magnesia.

Another portion of the ash was dissolved in water, acidulated with nitric acid, filtered, and divided into three portions. One portion was treated by nitrate of baryta, to determine the *sulphuric acid*, and by nitrate of silver, to determine the *chlorine*.

A second portion was treated by antimoniate of potash, to determine the soda; a *third*, by chloride of platina, to determine the *potassa*, and the nitric acid was estimated from another portion of the ash, by Pelouze's process.

The several extracts gave as follows:—

	Ordinary cultivation.	Guano.	Nitrate of potash.	Nitrate of soda.
Silica . . .	35·558	26·371	28·382	27·392
Phosphate of lime .	35·153	38·815	32·161	33·022
Carbonate of lime .	4·723	4·440	8·129	7·144
Phosphate magnesia .	6·932	10·764	5·231	5·707
Carbonate potash .	7·950	8·106	11·407	5·761
Sulphate potash .	1·895	2·860	3·012	1·769
Chloride potassium .	2·441	1·326	2·254	1·196
Nitrate potash . .	1·509	1·500	4·299	1·196
Oxide of iron . .	1·509	1·818	1·332	1·191
Alumina . . .	0·923	612	1·803	0·722
Nitrate of soda . .	—	—	—	0·391
Carbonate of soda .	—	1·800	—	10·084
Lost	1·407	1·588	1·990	1·425
Total . .	100·000	100·000	100·000	100·000
Ashes . . .	17·283	23·364	28·358	23·048
Total salts of potassa	13·795	13·792	20·972	9·822
Total salts of soda .	—	1·800	—	13·475
Total both .	13·795	15·592	20·972	23·297
Total phosphates .	42·085	49·592	37·392	38·379

It should be observed that the sections watered were sufficiently near as not to cause any variation in the character of the soil. It will be seen that potassa exists in the ordinary extract naturally, and is increased by special treatment nearly 50 per cent., while soda does not, and by treatment with soda the potassa is lessened from the natural proportion about 30 per cent., the total of soda nearly equals the total of potassa in the natural, and the nitrate of soda and nitrate of potassa taken together, exceeding the nitrate of potassa in the one treated by it, leaving the inference that when potassa exists in the soil and soda does not, that the latter should be used, so as to afford the largest amount of nitrates, and showing the disposition of the plant to take up both, unless it shall be shown by further investigations that the plant in which nitrate of potash exists naturally affords the largest amount of alkaloid, which is hardly probable.

This analysis explains the cause of the appearance of nitrate of potash, in crystals, upon the surface of the inspissated extracts of hyoscyamus.

It is not difficult to determine the different matters of which a plant is composed, but it is quite another field of investigation to determine the manner in which these substances are produced, and follow the complicated processes which constitute vegetation. The multiplicity of operations continually going on in vegetation at the same time, the variety of substances formed out of the same compound, the harmony, skill, and certainty which attends all the operations, are too wonderful to pass our observation, and too important not to challenge thorough investigation.

The researches and discoveries of agricultural chemistry fully establish the fact that plants require for their growth and perfect development certain inorganic constituents, which are different in different classes of plants. And the object of our inquiry is to ascertain what inorganic constituents are indispensable for the growth of the cultivated narcotics and perfect development of those principles, upon which their value as medicinal agents depends.

The utility of alkalies in the form of nitrates, or, indeed, in any form, cannot be doubted; nor can their utility in the formation of organic alkaloids in plants be considered a question.

Liebig says "the existence of vegetable alkalies in combination with organic acids gives great weight to the opinion that alkaline bases in general are connected with the development of plants;" and it remains to be determined by further experiment and analysis, which salt is most efficient in the development of the peculiar alkaloids upon which the medicinal activity of each narcotic appears to almost entirely depend, establish the true source of the active principles of other classes, and ascertain by what process the development of resinous and neutral principles likewise depends. — *American Journal of Materia Medica.*

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures[1] *(adapted to a Juvenile Auditory) consisting of Illustrations of the Various Forces of Matter, i.e. of such as are called the Physical or Inorganic Forces — including an Account of their Relations to each other; by* M. FARADAY, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

LECTURE II. (Jan. 3, 1860.) — *Gravitation — Cohesion.*

Do me the favour to pay me as much attention as you did at our last meeting, and I shall not repent of that which I have proposed to undertake. It will be impossible for us to consider the Laws of Nature, and what they effect, unless we now and then give our sole attention, so as to obtain a clear idea upon the subject. Give me now that attention, and then I trust we shall not part without your knowing something about those Laws, and the manner in which they act. You recollect, upon the last occasion, I explained that all bodies attracted each other, and that this power we called *gravitation*. I told you that when we brought these two bodies [two equal sized ivory balls suspended by threads] near together they attracted each other, and that we might suppose that the whole power of this attraction was exerted between their respective centres of gravity; and, furthermore, you learned from me that if, instead of a small ball, I took a larger one, like *that* [changing one of the balls for a much larger one], there was much more of this attraction exerted; or, if I made this ball larger and larger, until, if it were possible, it became as large as the Earth itself — or, I might take the Earth itself, as the large ball — that *then* the attraction would become so powerful as to cause them to rush together in this manner [dropping the ivory ball]. You sit *there* upright, and I stand upright *here*, because we keep our centres of gravity properly balanced with respect to the earth; and I need not tell you that on the other side of this world the people are standing and moving about with their feet towards our feet, in a reversed position as compared with us, and all by means of this power of gravitation to the centre of the earth.

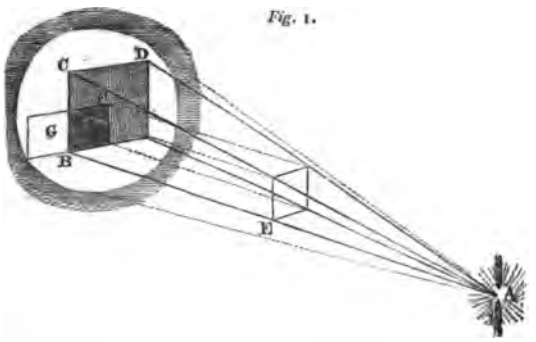
I must not, however, leave the subject of gravitation, without telling you something about its laws and regularity; and first, as regards its power with respect to the distance that bodies are apart. If I take one of these balls and place it within an inch of the other, they attract each other with a certain power. If I hold it at a greater distance off, they attract with less power, and if I hold it at a greater distance still, their attraction is still less Now this fact is of the greatest consequence; for, knowing this law, philosophers have discovered most wonderful things. You know that there is a planet, Uranus, revolving round the sun with us, but eighteen hundred millions of miles off; and because there is another planet as far off as three thousand millions of miles, this law of attraction, or gravitation, still holds good, and philosophers actually discovered this latter planet, Neptune, by reason of the effects of its attraction at this overwhelming distance. Now I want you clearly to understand what this law is. They say (and they are right) that two bodies attract each other *inversely as the square of the distance*, — a sad jumble of words until you understand them; but I think we shall soon comprehend what this law is, and what is the meaning of the "inverse square of the distance."

I have here (*fig.* 1.) a lamp A, shining most intensely upon this disc B, C, D, and this light acts as a sun by which I can get a shadow from this little screen E F (merely a square piece of card), which, as you know, when I place it close to the large screen, just shadows as much of it as is exactly equal to its own size; but now let me take this card E, which is equal to the other one in size, and place it midway between the lamp and the screen; now look at the size of the shadow D D, it is four times

[1] Reported verbatim by special permission.

the original size. Here, then, comes the "inverse square of the distance." This distance A E, is *one*, and that distance A B, is *two*, but that size E being *one*, this size B D of shadow is *four*

Fig. 1.

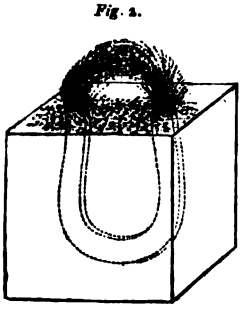


instead of *two*, which is the *square* of the distance; and, if I put the screen at one third of the distance from the lamp, the shadow on the large screen would be *nine* times the size. Again, if I hold this screen *here* at B F, a certain amount of light falls on it; and if I hold it nearer the lamp at E, *more* light shines upon it. And you see at once how much—exactly the quantity which I have shut off from the part of this screen B D, now in shadow; moreover, you see that if I put a single screen here at G, by the side of the shadow, it can only receive *one fourth* of the proportion of light which is obstructed. That, then, is what is meant by the *inverse* of the square of the distance. This screen E is the brightest because it is the nearest, and there is the whole secret of this curious expression *inversely as the square of the distance*. Now, if you cannot perfectly recollect this when you go home, get a candle and throw a shadow of something—your profile, if you like—on the wall, and then recede or advance, and you will find that your shadow is exactly in proportion to the *square* of the distance you are off the wall; and then if you consider how much light shines on you at one distance, and how much at another, you get the inverse accordingly. So it is as regards the attraction of these two balls, they attract according to the square of the distance, inversely. I want you to try and remember these words, and then you will be able to go into all the calculations of astronomers as to the planets and other bodies, and tell why they move so fast, and why they go *round* the sun without falling into it, and be prepared to enter upon many other interesting inquiries of the like nature.

Let us now leave this subject which I have written upon the board under the word Force—Gravitation—and go a step further. All bodies attract each other at sensible distances. I showed you the electric attraction on the last occasion (though I did not call it so); that attracts at a distance; and in order to make our progress a little more gradual, suppose I take a few iron particles [dropping some small fragments of iron on the table]. There, I have already told you that in all cases where bodies fall, it is the *particles* that are attracted. You may consider these then as separate particles magnified, so as to be evident to your sight; they are loose from each other—they all gravitate—they all fall to the earth—for the force of gravitation *never* fails. Now, I have here a centre of power which I will not name at present, and when these particles are placed upon it, see what an attraction they have for each other.

Here I have an arch of iron filings (*fig.* 2.) regularly built up like an iron bridge, because I have put them within a sphere of action which will cause them to attract each other. See!—I could let a mouse run through it, and yet if I try to do the same thing with them *here* [on the table] they do not attract each other at all. It is *that* [the magnet] which makes them hold together. Now just as these iron particles hold together in the form of an elliptical bridge, so hhdhe different particles of iron which constitute this nail hold together and make it one. And here is a bar of iron; why, is it only because the different parts of *this* iron are so wrought as to keep close together by the attraction *between* the particles, that it is held together in one mass. It is kept together, in fact, merely by the attraction of one particle to another, and that is the point I want now to illustrate. If I take a piece of flint and strike it with a hammer and break it thus [breaking off a piece of the flint], I have done nothing more than separate the particles which compose these two pieces so far apart, that their attraction is too weak to cause them to hold together, and it is only for that reason that there are now two pieces in the place of one. I will show you an experiment to prove that this attraction does still exist in those particles, for here is a piece of glass (for what was true of the flint and the bar of iron is true of the piece of glass, and is true of every other solid, they are all held together in the lump by the attraction between their parts), and I can show you the attraction between its separate particles, for if I take these portions of glass which I have reduced to very fine powder you see that I can actually build them up into a solid wall by pressure between two flat surfaces. The power which I thus have of building up this wall is due to the attraction of the particles, forming as it were the cement which holds them together; and so in this case, where I have taken no very great pains to bring the particles together, you see, perhaps a couple of ounces of finely pounded glass standing as an upright wall—is not this attraction most wonderful? *That* bar of iron one inch square has such power of attraction in its particles—giving to it such strength—that it will hold up twenty tons weight before the little set of particles in the small space equal to one division across which it can be pulled apart, will separate. In this manner suspension bridges and chains are held together by the attraction of their particles, and I am going to make an experiment which will show how strong is this attraction of the particles. [The Lecturer here placed his foot on a loop of wire fastened to a support above, and swung with his whole weight resting upon it for some moments.] You see while hanging here all my weight is supported by these little particles of the wire, just as in pantomimes they sometimes suspend gentlemen and damsels.

Fig. 2.



How can we make this attraction of the particles a little more simple? There are many things which if brought together properly will show this attraction. Here is a boy's experiment (and I like a boy's experiment).—Get a tobacco-pipe, fill it with lead, melt it, and then pour it out upon a stone, and thus get a clean piece of lead (this is a better plan than scraping it—scraping alters the condition of the surface of the lead). I have here some pieces of lead which I melted this morning for the sake of making them clean. Now these pieces of lead hang together by the attraction of their particles, and if I press these two separate pieces close together, so as to bring their particles within the sphere of attraction, you will see how soon they become one. I have merely to give them a good squeeze, and draw the upper piece slightly round at the same time, and here they are as one, and all the bending and twisting I can give them will not separate them again; I have joined the lead together, not with solder, but simply by means of the attraction of the particles.

This however is not the best way of bringing those particles together, we have many better plans than that—and I will show you one that will do very well for juvenile experiments. There is some alum crystallised very beautifully by nature (for all things are far more beautiful in their natural than their artificial form), and here I have some of the same alum broken into fine powder. In it I have destroyed that force of which I have placed the name on this board—Cohesion, or the attraction exerted between the particles of bodies to hold them together. Now I am going to show you that if we take this powdered alum and some hot water, and mix them together, I shall dissolve the alum—all the particles will be separated by the water far more completely than they are here in the powder; but then, being in the water, they will have the opportunity as it cools (for that is the condition which favours their coalescence) of uniting together again and forming one mass.

Now having brought the alum into solution, I will pour it into this glass basin, and you will, to-morrow, find that those particles of alum which I have put into the water, and so separated that they are no longer solid, will as the water cools, come together and cohere, and by to-morrow morning we shall have a great deal of the alum crystallised out, that is to say, come back to the solid form. [The Lecturer here poured a little of the hot solution of alum into the glass dish, and when the latter had thus been made warm, the remainder of the solution was added.] I am now doing that which I advise you to do if you use a glass vessel,

namely, warming it slowly and gradually; and in repeating this experiment do as I do; pour the liquid out gently, leaving all the dirt behind in the basin; and remember that the more carefully and quietly you make this experiment at home, the better the crystals. To-morrow you will see the particles of alum drawn together, and if I put two pieces of coke in some part of the solution (the coke ought first to be washed very clean, and dried), you will find to-morrow that we shall have a beautiful crystallisation over the coke, making it exactly resemble a natural mineral.

Now how curiously our ideas expand by watching these conditions of the attraction of cohesion — how many new phenomena it gives us beyond those of the attraction of gravitation. See how it gives us great strength. The things we deal with in building up the structures on the earth are of strength — we use iron, stone, and other things of great strength; and only think that all those structures you have about you — think of the Great Eastern if you please, which is of such size and power as to be almost more than man can manage — are the result of this power of cohesion and attraction.

I have here a body in which I believe you will see a change taking place in its condition of cohesion at the moment it is made. It is at first yellow, it then becomes a fine crimson red Just watch when I pour these two liquids together — both colourless as water. [The Lecturer here mixed together solutions of perchloride of mercury and iodide of potassium, when a yellow precipitate of biniodide of mercury fell down, which almost immediately became crimson red.] Now, there is a substance which is very beautiful, but see how it is changing colour. It was reddish-yellow at first, but it has now become red. I have previously prepared a little of this red substance, which you see formed in the liquid, and have put some of it upon paper. [Exhibiting several sheets of paper coated with scarlet biniodide of mercury.] There it is — the same substance spread upon paper, and there too is the same substance; and here is some more of it [exhibiting a piece of paper as large as the other sheets, but having only very little red colour on it, the greater part being yellow], a *little* more of it, you will say. Do not be mistaken; there is as much upon the surface of one of these pieces of paper as upon the other. What you see yellow is the same thing as the red body, only the attraction of cohesion is in a certain degree changed; for I will take this red body, and apply heat to it (you may perhaps see a little smoke arise, but that is of no consequence), and if you look at it it will first of all darken — but see, how it is becoming yellow. I have now made it all yellow, and what is more it will remain so; but if I take any hard substance, and rub the yellow part with it, it will immediately go back again to the red condition. [Exhibiting the experiment.] There it is. You see the red is not *put back*, but *brought back* by the change in the substance. Now [warming it over the spirit lamp] here it is becoming yellow again, and that is all because its attraction of cohesion is changed. And what will you say to me when I tell you that this piece of common charcoal is just the same thing, only differently coalesced, as the diamonds which you wear. (I have put a specimen outside of a piece of straw which was charred in a particular way — it is just like black lead). Now, this charred straw, this charcoal, and these diamonds, are all of them the same substance, changed but in their properties as respects the force of cohesion.

Here is a piece of glass [producing a piece of plate glass about two inches square], (I shall want this afterwards to look at and examine its internal condition)—and here is some of the same sort of glass differing only in its power of cohesion, because while yet melted it has been dropped into cold water [exhibiting a "Prince Rupert's drop" (*fig.* 3.)], and if I take one of these little tear-like pieces and break off ever so little from the point, the whole will at once burst and fall to pieces. I will now break off a piece of this. [The Lecturer nipped off a small piece from the end of one of the Rupert's drops, whereupon the whole immediately fell to pieces.] There! you see the solid glass has suddenly become powder, and more than that, it has knocked a hole in the glass vessel in which it was held. I can show the effect better in this bottle of water, and it is very likely the whole bottle will go. [A 6-oz. vial was filled with water, and a Rupert's drop placed in it with the point of the tail just projecting out; upon breaking the tip off, the drop burst, and the shock being transmitted through the water to the sides of the bottle, shattered the latter to pieces.]

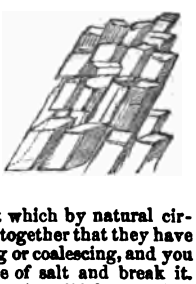
Here is another form of the same kind of experiment. I have here some more glass which has not been annealed, [showing some thick glass vessels (*fig.* 4.)], and if I take one of these glass vessels and drop a piece of pounded glass into it (or I will take some of these small pieces of rock crystal—they have the advantage of being harder than glass) and so make the least scratch upon the inside, the whole bottle will break to pieces,—it cannot hold together. [The Lecturer here dropped a small fragment of rock crystal into one of these glass vessels, when the bottom immediately came out and fell upon the plate.] There it goes through, just as it would through a sieve.

Fig. 3.

Fig. 4.

Now, I have shown you these things for the purpose of bringing your minds to see that bodies are not merely held together by this power of cohesion, but that they are held together in very curious ways. And suppose I take some things that are held together by this force, and examine them more minutely. I will first take a bit of glass, and if I give it a blow with a hammer I shall just break it to pieces. You saw how it was in the case of the flint when I broke the piece off; a piece of a similar kind would come off, just as you would expect; and if I were to break it up still more, it would be as you have seen, simply a collection of small particles of no definite shape or form. But supposing I take some other thing, this stone for instance (*fig.* 5.) [taking a piece of mica], and if I hammer this stone I may batter it a great deal before I can break it up. I may even bend it without breaking it; that is to say, I may bend it in *one particular direction* without breaking it much, although I feel in my hands that I am doing it some injury. But now, if I take it by the edges I find that it breaks up into leaf after leaf in a most extraordinary manner, Why should it break up like that? Not because all stones do. or all crystals; for there is some salt — (*fig.* 6.)—you know what

Fig. 5. *Fig.* 6. *Fig.* 7.

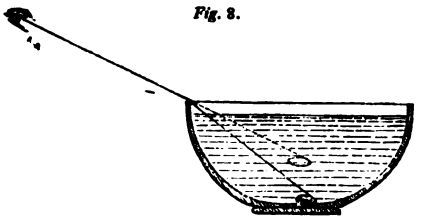


common salt is; here is a piece of this salt which by natural circumstances has had its particles so brought together that they have been allowed free opportunity of combining or coalescing, and you shall see what happens if I take this piece of salt and break it. It does not break as flint did, or as the mica did, but with a clean sharp angle and exact surfaces, beautiful and glittering as diamonds [breaking it by gentle blows with a hammer]; there is a square prism which I may break up into a square tube. You see these fragments are all square—one side may be longer than the other, but they will only split up so as to form square or oblong pieces with cubical sides. Now, I go a little further, and I find another stone (*fig.* 7.) [Iceland, or calc-spar], which I may break in a similar way, but *not* with the same result. Here is a piece which I have broken off, and you see there are plain surfaces perfectly regular with respect to each other, but it is not cubical — it is what we call a rhomboid. It still breaks in three directions most beautifully and regularly with polished surfaces, but with *sloping* sides, not like the salt. Why not? It is very manifest that this is owing to the attraction of the particles one for the other being less in the direction in which they give way than in other directions. I have on the table before me a number of little bits of calcareous spar, and I recommend each of you to take a piece home, and then you can take a knife and try to divide it in the direction of any of the surfaces already existing. You will be able to do it at once — but if you try to cut it *across* the crystals you cannot; by hammering, you may bruise and break it up — but you can only divide it into these beautiful little rhomboids.

Now I want you to understand a little more how this is — and for this purpose I am going to use the electric light again. You

see, we cannot look into the *middle* of a body like this piece of glass. We perceive the outside form, and the inside form, and we look *through* it, but we cannot well find out how these forms become so, and I want you therefore to take a lesson in the way in which we use a ray of light for the purpose of seeing what is in the interior of bodies. Light is a thing which is, so to say, attracted by every substance that gravitates (and we do not know any thing that does not). All matter affects light more or less by what we may consider as a kind of attraction, and I have arranged (*fig.* 8.)

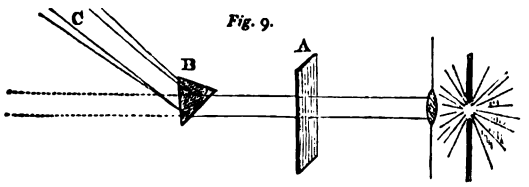
Fig. 8.



a very simple experiment upon the floor of the room for the purpose of illustrating this. I have put into that basin a few things which those who are in the body of the theatre will not be able to see, and I am going to make use of this power which matter possesses of attracting a ray of light. If Mr. Anderson pours some water gently and steadily into the basin, the water will attract the rays of light downwards, and the piece of silver and the sealing wax will appear to rise up into the sight of those who were before not high enough to see over the side of the basin to its bottom. [Mr. Anderson here poured water into the basin, and upon the Lecturer asking whether any body could see the silver and sealing wax he was answered by a general affirmative]. Now I suppose that everybody can see that they are not at all disturbed, whilst from the way they appear to have risen up, you would imagine the bottom of the basin and the articles in it were two inches thick, although they are only one of our small silver dishes and a piece of sealing-wax which I have put there. the light which now goes to you from that piece of silver was obstructed by the edge of the basin when there was no water there, and you were unable to see anything of it; but when we poured in water, the rays were attracted down by it over the edge of the basin and you were thus enabled to see the articles at the bottom.

I have shown you this experiment first, so that you might understand how glass attracts light, and might then see how other substances like rock salt and calcareous spar, mica and other stones would affect the light; and if Dr. Tyndall will be good enough to let us use his light again, we will first of all show you how it may be bent by a piece of glass (*fig.* 9.) [The electric

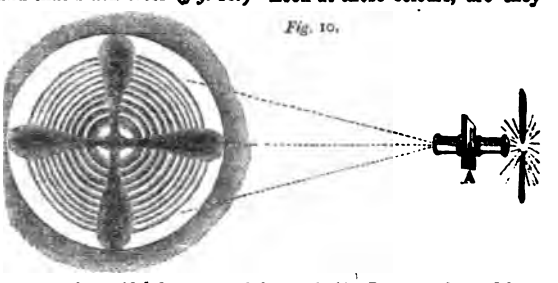
Fig. 9.



lamp was again lit, and the beam of parallel rays of light which it emitted was bent about and decomposed by means of the prism.] Now here you see, if I send the light through this piece of plain glass A, it goes straight through without being bent (unless the glass be held obliquely, and then the phenomenon becomes more complicated), but if I take this piece of glass B [a prism], you see it will show a very different effect. It no longer goes to that wall, but it is bent to this screen C, and how much more beautiful it is now [throwing the prismatic spectrum on the screen]. This ray of light is bent out of its course by the attraction of the glass upon it. And you see I can turn and twist the rays to and fro in different parts of the room just as I please. Now it goes there, now here. [The Lecturer projected the prismatic spectrum about the theatre.] Here I have the rays once more bent on to the screen, and you see how wonderfully and beautifully that piece of glass not only bends the light by virtue of its attraction, but actually splits it up into different colours. Now I want you to understand that this piece of glass [the prism] being perfectly uniform in its internal structure, tells us about the action of these other bodies which are not uniform—which do not merely *cohere*, but also have within them, in different parts, different *degrees of cohesion*, and thus attract and bend the light with varying powers. We will now let the light pass through one or two of these things which I just now showed you broke so curiously; and first of all I will take a piece of mica. Here you see is our ray of light—we have first to make it what we call *polarised*, but about that you need not trouble yourselves, it is only to make our illustration more clear. Here, then, we have our polarised ray of light, and I can so adjust it as to make the screen upon which it is shining either light or dark, although I have nothing in the course of this ray of light but what is perfectly transparent [turning the *analyser* round]. I will now make it so that it is quite dark, and we will in the first instance put a piece of common glass into the polarised ray so as to show you that it does not enable the light to get through. You see, the screen remains dark. The glass then, internally, has no effect upon the light. [The glass was removed, and a piece of mica introduced.] Now, there is the mica which we split up so curiously into leaf after leaf, and see how that enables the light to pass through to the screen, and how, as Dr. Tyndall turns it round in his hand, you have those different colours, pink, and purple, and green, coming and going most beautifully;—not that the mica is more transparent than the glass, but because of the different manner in which its particles are arranged by the force of cohesion.

Now we will see how calcareous spar acts upon this light,—that stone which split up into rhombs, and of which you are going to take a little piece home each of you. [The mica was removed, and a piece of calc spar introduced at A.] See how that turns the light round and round, and produces these rings and that black cross (*fig.* 10.) Look at those colours, are they

Fig. 10.



not most beautiful for you and for me? (for I enjoy these things as much as you do.) In what a wonderful manner they open out to us the internal arrangement of the particles of this calcareous spar by the force of cohesion.

And now I will show you another experiment. Here is that piece of glass which before had no action upon the light. You shall see what it will do when we apply pressure to it. Here, then, we have our ray of polarised light, and I will first of all show you that the glass has no effect upon it in its ordinary state,—when I place it in the course of the light, the screen still remains dark. Now Dr. Tyndall will press that bit of glass between three little points, one point against two, so as to bring a strain upon the parts, and you will see what a curious effect that has. [Upon the screen two white dots gradually appeared]. Ah! these points show the position of the strain—in these parts the force of cohesion is being exerted in a different degree to what it is in the other parts, and hence it allows the light to pass through. How beautiful that is—how it makes the light come through some parts and leaves it dark in others, and all because we weaken the force of cohesion between particle and particle. Whether you have this mechanical power of straining, or whether we take other means, we get the same result, and, indeed, I will show you by another experiment that if we heat the glass in one part it will alter its internal structure, and produce a similar effect. Here is a piece of common glass, and if I insert this in the path of the polarised ray, I believe it will do nothing. There is the common glass [introducing it]—no light passes through—the screen remains quite dark; but I am going to warm this glass in the lamp, and you know yourselves that when you pour warm water upon glass you put a strain upon it sufficient to break it sometimes—something like there was in the case of the Prince Rupert's drops. [The glass was warmed in the spirit lamp, and again placed across the ray of light.] Now you see how beautifully the light goes through those parts which are hot, making dark and light lines just as the crystal did, and all because of the alteration I have effected in its internal condition; for these dark and light parts are a proof of the presence of forces acting and dragging in different directions within the solid mass.

(*The third Lecture*, on Cohesion *and* Chemical Affinity, *will appear in our next.*)

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY, *January* 4, 1860.

T. N. R. Morson, Esq. *President, in the Chair.*

The first paper was read *On the Preparation of Lard for Pharmaceutical purposes;* by Mr. T. H. Hills.

Mr. Hills believes that lard acquires its bad smell owing to the presence of a disagreeable odorous matter which is found between the lard and the membrane from which it is separated. When prepared in the usual way this odorous matter is dissolved and becomes diffused through the whole of the lard. In order to get rid of it and obtain the lard quite pure, Mr. Hills cuts up the flair, and before melting places it in a vessel with a perforated bottom (a sort of colander), and keeps a stream of water running through, squeezing and stirring the mass continually, so that every part of it may be exposed to the action of the water. By this means the odorous matter is washed away. Afterwards the lard is melted and strained from the membrane. Prepared in this way lard will keep without smell for 9 or 12 months. When *benzoated* lard is prepared, bruised benzoin is added previous to the melting, and the whole is maintained at a gentle heat for two hours and then strained.

Mr. Buckle had found it advisable to remove all the fat immediately around the kidneys and ureters (which always had a bad odour) before the lard was made. If this were done it might be prepared in the usual way without possessing any smell. He heated it to ebullition to get rid of the water.

Mr. Wright said that perfumers were the largest consumers of prepared lard, and they made it by cutting up the flair and boiling it with water, throwing in about 2 oz. of alum to the cwt. to coagulate albuminous and fibrinous matters, which they skimmed off.

Mr. Hills replied that the odorous secretion of which he had spoken was soluble in the heated lard, and could only be got rid of by washing with cold water, as he had described.

The next paper was *On Pilulæ*, by Mr. B. S. Proctor of Newcastle. The object in making pills was to form active ingredients into a mass with substances which should give plasticity, and at the same time promote the solubility, and obviate any liability to change. He believed it best to make only small quantities of a mass at a time, and for this reason recommended that the ingredients should be kept in powder ready to be made up with water, or what was most advisable, when the pills were required. If this plan were generally adopted he believed that the change would be acceptable to many. The objection that the ingredients of Plummer's pills were liable to separate he considered of no value. No objection was made to the keeping of powders (*e. g.* Dover's powder) on the same account. Making a solution of the ingredients, and then evaporating to a proper consistence, he thought had only a theoretical advantage, while the fact that pills made in this way soon fell out of shape was a positive disadvantage. Wholesale manufacturers who never saw pills after they had been in a patient's possession for a month, he did not consider were the best judges of what would form a good mass. A variety of pills might be made up with glycerine. Pil. rhei co. made up with it becomes tough and keeps well. Made up with treacle the mass is tough when new, but becomes hard. The best excipient perhaps was a mixture of 3 parts of treacle, 9 parts glycerine, and 4 parts water. The use of tragacanth, which had been condemned, was at times advisable. A small quantity of it removed the stickiness of the blue pill. Pills compounded of aloes and resins usually were of a bad shape. They were best made by dissolving the ingredients and evaporating with some substance which would give support to the mass. What he had found answer this purpose best was fine sawdust, which had passed through a sieve with about 40 meshes to the inch. If it were objected that sawdust was a vulgar substance, pure lignin or calisaya bark might be used, which would answer equally well. He had found that 60 grains of aloes could be made into a mass which kept its shape with 6 grains of sawdust and 6 minims of glycerine. Extract of gentian was often used to make aloes into a mass, under an impression that a bitter increased the action of the aloes. If this really were so he submitted that calisaya bark would answer the purpose just as well.

There was no discussion on this paper, for as soon as the reading was finished Mr. Waugh introduced a knife-cleaning machine to the notice of the meeting. It was made of two boards, one side of each having a cushion of felt over which was fixed a strip of buckskin leather—the leather surfaces being pressed together by means of screws passing through the ends of the boards. At the middle of the upper board was a small tin funnel through which emery powder could be passed to the cushions.

Mr. Hills then read a paper *On the Extract and Fluid Extract of Taraxacum.* He thought it best to collect the roots at the end of autumn or beginning of winter, after a little frosty weather. They should be washed, crushed, and then pressed, and the liquor should be boiled for a quarter of an hour. It ought then to be strained, and evaporated at a temperature from 80° to 100°. If the heat were increased to 212° the extract would become mouldy. If the fluid extract were required, 25 per cent. of spirit should be added to the juice, which should then be allowed to stand for the precipitate to separate, and then strained. The juice should never be heated, as it would not then keep well. With 20 per cent. of spirit he had found it keep well 12 months. To make extract from the dried root, it should be ground, and then percolated with 1 part of spirit and 4 of water, and the solution evaporated at a low temperature, as before.

Professor Bentley differed from Mr. Hills as to the time the root should be collected. The quality differed a good deal at different times of the year, and the goodness he considered to depend on the amount of bitter principle it contained. There was most of this in the spring. After a frost the root became sweet, which he believed was owing to the conversion of inuline into sugar; an opinion which was confirmed by analysis, which had shown that roots collected in autumn contain 2¼ ounces of inuline in the pound, while those collected in the spring had only a trace. He should like to see extracts prepared from roots collected in spring, autumn, and winter.

[The professor did not explain whether the bitter principle disappeared during the conversion of inuline into sugar, or whether its taste was merely covered by the sweetness of the sugar.]

Mr. Hanbury said that the Messrs. Smith of Edinburgh had shown that mannite was the saccharine principle developed in making the extract, and that none was formed if the process was well conducted. It was only when the roots were left long about, or when the process was prolonged, that mannite was developed. He thought some difficulty would be experienced in obtaining the roots in spring, as they were usually got when land was dug up in autumn.

A communication from Dr. Brett, *On Arsenical Fly Papers*, was then read. The Dr. had found two kinds of these papers; one which contained arsenic acid in combination with potash, and the other which contained only arsenious acid. In analysing the first the hydrochloric solution should be boiled with sulphurous acid before the arsenic was precipitated with sulphuretted hydrogen, or the arsenic would be under-estimated. The well-known *Papier Moure* belonged to the first class. He had analysed six specimens of arsenical fly papers, and had found one which contained as much as 15 per cent. of arsenious acid. He considered that they ought not to be sold, as their use was attended with danger.

Mr. Porrett said the use of polished visiting cards was dangerous to children. Cases of lead colic had occurred in children who had sucked these cards.

At the conclusion of the meeting Professor Redwood

rose to correct an error in the last number of the *Pharmaceutical Journal*. It was there stated that the sale of cocoa with dandelion did not require an excise license, but this had been found to be mistake, and he had thought it right to inform the members of it at once.

Mr. Buckle said he had made and sold *essence* of cocoa without a license, and he did not believe that one was required for essence of coffee.

A Member suggested that all difficulty about the sale of dandelion coffee might be removed if the dandelion were sold by itself, with a label directing the purchaser to mix it with an equal quantity of coffee when it was used. The meeting then adjourned.

Chemical Society.—We are requested to give notice that the next meeting of the Chemical Society will take place on Thursday the 19th inst., when several papers on Metallurgical Chemistry will be read.

NOTICES OF BOOKS, PATENTS, &c.

The Retrospect of Medicine: being a half-yearly Journal containing a retrospective view of every discovery and practical improvement in the Medical Sciences. Edited by W. Braithwaite, *Lecturer on Obstetric Medicine at the Leeds School of Medicine.* Simpkin, Marshall & Co. 1860.

The fortieth half-yearly volume of this valuable compilation is already before us. It contains a clear and well selected abstract of most of the papers of interest which appeared in the British Medical Journals from July to December of last year; and the promptitude with which the volume has been issued is highly creditable to both editor and publisher. As a matter of course, the work is intended for medical men, and contains but little of special interest to the mere chemist and druggist. But as we are not of the number who believe that the less a druggist knows of medicines beyond their prices and appearances, the better it is for himself, the public, and the medical profession, we shall always feel it our duty when giving an account of new medicines not only to notice their natural history, chemistry, and preparation, but also their effects and therapeutical uses. Not, however, with any view to assist chemists and druggists in prescribing, but because we believe it to be as important that they should know the properties of the articles they sell and compound, as that a man who deals in gunpowder should be aware of its explosiveness.

During the past half year, but few novelties have been introduced into our Materia Medica. A new diuretic has been found in the *Erodium Cicutarium*, or Stork's-bill, which grows abundantly on the sand-hills around our coast. It is administered in the form of an infusion made by steeping an ounce of the dried plant (every part of it) in 3 pints of water, and evaporating at a gentle heat to 2 pints. The dose of this infusion for an adult is 4 or 5 ounces 3 times a day.

Another novelty is *Saccharated Lime*, which is recommended as the best antacid which can be had. The way it is prepared is as follows:—

"Slake 8 ounces of quick lime; rub up with it 5 ounces of white sugar; add one pint of water; stir for some time until the hard stiff masses, which the sugar and lime are liable to run into, are as much as possible dissolved; then filter. The product should be perfectly clear and only of a slightly yellowish tint. A solution made in this way will contain 18 grains of lime in every ounce by weight."

It is given in doses of 20 or 30, or even 60 or more minims in a glass of water, two or three times a day, and is said by Dr. Cleland to be very useful in some forms of dyspepsia, in gout, and in checking diarrhœa.

Ozonised oils, that is, oils which have been saturated with oxygen and then exposed for some time to the direct rays of the sun, are said to have a remarkable tendency to reduce the frequency of the pulse. Cocoa-nut oil, sunflower oil, and cod-liver oil have been ozonised and used with great advantage in consumption, and no doubt ozonised cod-liver oil will soon be in demand. Ozonised oil of turpentine has also been used as a styptic.

A new and potent drug, the *Veratrum Viride*, has been extensively used in America. American practitioners tell us that by exhibiting in repeated doses a concentrated tincture of the *veratrum viride* they can reduce the pulse and keep it reduced with a certainty and to a degree which can be effected by no other drug. The *veratrum viride* is an American plant, but Dr. Simpson thinks that the same indications may be fulfilled with the *veratrum album*. We are not informed how the tincture was made, but the dose appears to have been from 3 to 10 drops.

Mercurial cigarettes have been recommended for several diseases. They are made by dissolving 15 grains of nitrate of mercury in 15 minims of strong nitric acid diluted with 6 drachms of water, and soaking in the solution strips of thick white blotting paper. These are rolled into cigarettes before they are quite dry, and gummed along the edge.

A disinfecting powder, made by mixing 100 parts of plaster of Paris with from 1 to 5 parts of coal tar, has been used with advantage in the Paris hospitals. The powder, it will be seen, resembles Mr. Dougall's. It may be made into a sort of ointment by rubbing it up with olive oil, and then may be applied directly to a wound.

Sulphuric ether is again coming into use as an anæsthetic. The only objections made to its employment were the time and the quantity of ether it required to get a patient fully under the influence. It seems odd that a few pence and a few minutes should be so much considered when life is at stake; but people are at times strangely economical, and operating surgeons are a peculiarly irritable race. While, however, chloroform remains in use, it is very important that our readers should know every means by which its purity can be ascertained, so we quote the following:

"Chloroform may contain chloride of elaidine, alcohol, various chlorides, amylic and methylic combinations, and aldehyde. By adding caustic potash to chloroform containing chloride of elaidine the compound is transformed into chloride of acetyle, the fœtor of which is immediately noticed. In order to ascertain the presence of all the other compounds which may be mixed with the chloroform, especially alcoholic compounds, pound a small quantity of bichromate of potash in a little chloroform, and add to this mixture a few drops of sulphuric acid. If the chloroform is pure, a reddish brown precipitate of chromic acid is formed; if not pure the acid is reduced, whilst the precipitate and sometimes the liquid itself assumes a green colour, dependent on the presence of the sesquioxide of chromium."

Mr. Braithwaite's *Retrospect* is too well known to medical men to need any recommendation from us. All we can say is that the present volume maintains the reputation of those which have preceded it.

Improvements in making extracts from Liquorice Root. A. W. Williamson, 1859.

Professor Williamson's object is to obtain a larger quantity of extract than is obtained by merely boiling the liquorice root in the usual way. With this idea he first exhausts the air dried root with water in any convenient manner, and afterwards boils it in fresh water containing about three fifths per cent. of dry potash in proportion to the original weight of dry root. After sufficient boiling, he separates this decoction, and evaporates it with the solution previously obtained to dryness, or any convenient consistence. Part of the potash may be replaced by an equivalent quantity of caustic soda.

We do not know that the amount of alkali an extract so made will contain is of much importance, but we are certain that it can be of no advantage; in some cases in which liquorice extract is used in pharmacy it may be decidedly objectionable. In any case, however, it seems — what shall we say — extraordinary, to see an accomplished chemist taking out a patent for boiling liquorice root in a little alkaline water.

CORRESPONDENCE.

Druggists' Labels.

To the Editor of the Chemical News.

Sir, — The letter of your correspondent * * * * contained a very good suggestion to which I would add another, which is that the labels in the retail department should all be in plain English. Why should any one coming for two or three pennyworth of tincture of rhubarb be served from a bottle mysteriously labelled Tinct. Rhei? or why should not black draught have black draught plainly written on it, instead of Haust Sennæ, or something else even less explicit? The absurdity of these things must be evident to all, and one wonders that the foolish and pedantic practice should be so general. If there be any excuse for those I have instanced above, there surely can be none for keeping arrowroot in a drawer labelled Fec. Marantæ, or Epsom salts in vessels marked Magnes. Sulph. These are quite as ridiculous as the case of a country druggist who sold gunpowder, and kept it in a drawer labelled Pulv. Pro. Gun!!

I know that it is not possible for every one to have a distinct dispensing department, but whenever it can be done I am sure it would be well to follow the practice I have suggested. Retail customers will be better satisfied when they can read the labels on the drawers and bottles from which they are served, and the mystery of a prescription can be just as well kept up if it be necessary.—I am, &c.

Cui Bono.

Mechanical Antidote for Arsenic.

To the Editor of the Chemical News.

Sir, — The present excitement about poisons reminds me to communicate a method of treating a case of poisoning by arsenic when it has been taken in a solid form, which I have seen used several times with perfect success, but never remember to have seen in print.

It consists in first evacuating the contents of the stomach and then well washing it out, and afterwards administering a good quantity of prepared chalk and castor oil, mixed together to the consistence of thick cream. The patient is made to eat a pound or more of this compound, which invests every particle of arsenic left adhering to the mucous membrane of the stomach, and carries it harmless through the remainder of the alimentary canal. Only one of several cases I have seen treated in this way proved fatal. One case in which a man had made a very determined attempt at suicide by swallowing arsenic and powdered nux vomica together, recovered after the treatment: the nux vomica symptoms, which were well marked, being combated with large doses of extractum conii.

The remedy is of Scottish origin, I believe, and was introduced at the London Hospital by Mr. Macmeikan, formerly apothecary to that institution.

I may add that the mixture of chalk and castor oil, flavoured with assafœtida and powdered gentian, and eaten with a teaspoon, has been found good *moral* treatment for an intended suicide, who has been supplied by a ready-witted druggist with cream of tartar or some other harmless substance in the place of a poison.—I am, &c.

W. T. Fewtrell.

Chemical Notices from Foreign Sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

Nitride of Selenium.—Professor Wöhler has lately addressed to the *Société Chimique* of Paris [1] the following note upon nitride of selenium:—"Having made one of my pupils, M. Espenschied, endeavour to obtain nitride of selenium, a compound hitherto unknown, we have succeeded perfectly in forming this compound. White volatile chloride of selenium is prepared (which probably is not $SeCl_2$ but $SeCl_4$); it is submitted, in a tube, to cold produced by a mixture of ice and common salt, after which a great excess of ammonia gas, perfectly dry, is passed over it. In this manner a brown matter is obtained, which appears to be a mixture of chloride of ammonium and nitride of selenium. At the ordinary temperature of the atmosphere the reaction is so vehement that only pure selenium, containing no nitrogen, is produced. By treating the brown matter with water the nitride of selenium is obtained, when it may be dried at a low temperature.

"Nitride of selenium is an amorphous powder of a fine red colour. It is a dangerous body to manipulate; when it is heated, rubbed, or struck with the hammer, it produces a violent explosion, and evolves into the air red fumes of selenium.

"M. Espenchied is at present occupied with the analysis of this new substance; at the same time he is endeavouring to produce, under the same conditions, *nitride of sulphur*."

Molybdate of Ammonia.—Since molybdate of ammonia has been employed in laboratories to detect the presence of phosphoric acid, many processes have been proposed for preparing molybdic acid. This acid is obtained generally by roasting the native sulphide of molybdenum in clay basins. M. Brunner [2] recommends a new method of performing this operation. The mineral is pulverised and mixed with an equal volume of quartzose sand; the mixture is then roasted in a platinum capsule until the mass has acquired a yellow lemon colour. After cooling the molybdic acid is extracted by exhausting the product with ammonia.

Transformation of Sulphate of Lead into Acetate.—This important industrial problem has lately been solved in a very satisfactory manner by M. Kraft.[3] Sulphate of lead is formed daily as a residue of the manufactory of of acetate of alumina for the dyers. To render this substance valuable, M. Kraft transforms it anew into acetate of lead, which can again react upon alum, and form acetate of alumina. First of all it is necessary to purify the sulphate of lead residue of the manufactories, by washing it with water containing sulphuric acid, or to destroy the organic matter it often contains, by calcining it in thin layers, and in contact with the air. This first operation terminated, 100 parts of the sulphate are taken, and boiled with 84 parts of *acetate of baryta* dissolved in as little water as possible. The reaction takes place rapidly, and can be effected easily, but at the expense of time, without the application of heat. The precipitate of sulphate of baryta formed is allowed to deposit itself, and the clear solution of acetate of lead is drawn off. The double decomposition takes place quite as well if the sulphate of lead be suspended in a bag, which is plunged into the solution of acetate of baryta. A slight excess of sulphate of lead is requisite. Now, to prepare the acetate of baryta employed, the author heats a mixture of sulphate of baryta (common heavy-spar) broken into small fragments, and charcoal, which gives him sulphide of barium. This dissolved in water is boiled with oxide of copper, forming hydrate of baryta and sulphide of copper. The solution of hydrate of baryta decanted off from the insoluble sulphide of copper, is saturated with acetic acid, and produces the solution of acetate of baryta employed as above. The sulphide of copper is transformed by roasting into oxide of copper, which serves again, &c.

If it is not essential to have the acetate of lead perfectly pure, instead of acetate of baryta *acetate of lime* may be used to decompose the sulphate of lead. For 100 parts of the latter 52 parts of acetate of lime are required. The latter salt is formed in large quantities in the manufactories of acetic acid, and if employed with care to decompose the sulphate of lead, very little lime passes into the solution of acetate of lead obtained.

[1] *Répertoire de Chimie*, No. 8, 1859.

[2] *Journ. für Praktische Chm.* lxxv. p. 129.

[3] *Répertoire de Chimie Appliquée*, No. 10, 1859.

II. ORGANIC CHEMISTRY.

On the Composition of several Essences.—Some years ago M. Biot submitted to M. Lallemand two vegetable products for examination. The first was the oil of the *Dryobalanops Camphora* collected by the well-known Dutch savaat Dr. Junguhn whilst journeying in the north-west of the island of Sumatra. The second, already known as *oil of camphor*, had been extracted from the *Laurus Camphora*, a plant which also furnishes the camphor of Japan. "The results at which I have arrived," says M. Lallemand[4], "differ with those already mentioned in works on chemistry, and render very probable the fact that the product analysed by M. Pelouze under the name of *essence of Borneo* had not been extracted from the *Dryobalanops Camphora* (the largest tree of the Indian Archipelago)." The researches contained in the author's paper show that the oil of Dryobalanops is a complex mixture analogous to the turpentine obtained from pines and firs. Its origin would make us suppose that it contained Borneo camphor: M. Lallemand assures us, however, that it does not contain a trace. The oil which exudes from the tree by incision does not differ from that obtained by decoction; they have both the same rotatory power and the same viscosity. The quantity experimented upon was too small to permit of further research. The camphor oil extracted from *Laurus Camphora* has already been analysed by Martius and Richer, who looked upon it as a first degree of oxidation of camphor, and represented it by the formula $C_{20}H_{16}O$. Gerhardt supposed it to be a mixture of camphor and a hydrocarbon, and M. Lallemand confirms this view.

"I have also determined," says the latter author, "the composition of some of the most abundant essences of the *Labiatæ* family, which I possessed in a pure state. The essentials oils of *rosemary*, of *common lavender* (*Lavandula spica*) and *cultivated lavender* consist of mixtures analogous to the oil of camphor, and show us to what extent the molecule $C_{20}H_{16}$ and its immediate derivatives are distributed throughout the vegetable world.

III. CHEMICAL ANALYSIS.

Separation and Determination of Phosphoric Acid.—M. Chancel[5] has published a new method for determining phosphoric acid when combined with protoxides. It is based upon the insolubility of the yellow phosphate of silver $3AgO.Po_5$, in a neutral liquid. The substance to be analysed is weighed, and dissolved in nitric acid; the solution is diluted with water; it is well not to employ too great an excess of nitric acid. To the clear liquid is added first a sufficient quantity of nitrate of silver, and then a slight excess of carbonate of silver. The saturation of the free nitric acid takes place rapidly without the application of heat; in a few moments the yellow phosphate of silver is thrown down. When the supernatant liquid no longer reddens litmus paper the precipitation is complete. The precipitate is collected on a filter and washed. When the washing is finished the filter is perforated with a platinum wire, and the whole of the precipitate washed out into a flask, and dissolved in nitric acid. The silver is then precipitated by hydrochloric acid, and in the filtrate the phosphoric acid is thrown down with an ammoniacal solution of sulphate of magnesia, and determined as usual.

Separation of Magnesia and Lithia.—M. Schaffgotsch showed some time ago[6] that magnesia can be separated from *potash* and *soda* by the following method. Neutral carbonates of ammonia and magnesia form together a double salt, which sesquicarbonate of ammonia precipitates at the ordinary temperature, when the solutions are concentrated and the sesquicarbonate in excess. This precipitate, which is first flocculent then granular, has for formula, $NH_4O, CO_2 + MgO.CO_2 + 4HO$—corresponding to 15·9 of magnesia in theory—experiment gave the author 15·5. The precipitate is almost insoluble in concentrated solutions of basic or neutral carbonate of ammonia. This insolubility has been turned to profit by the author to separate magnesia from potash and soda. It is, however, necessary to remark that after the washing, the double magnesian carbonate contains a notable quantity of carbonate of potash, but no carbonate of soda. It is therefore necessary to wash the residue of magnesia obtained by calcination, in order to eliminate this carbonate of potash.

The same author has more recently[7] found that this method is perfectly applicable to the separation of magnesia and lithia; carbonate of lithia being easily soluble in carbonate of ammonia.

[4] *Répertoire de Pharmacie*, Oct. 1859.
[5] *Comptes-Rendus*, Déc. 26, 1859.
[6] *Pogg. Ann.* civ. p. 482.
[7] *Pogg. Ann.* cvi. p. 294.

SCIENTIFIC NOTES AND QUERIES.

Peroxide of Lead in Lucifer Matches.—SIR,—In answer to your correspondent *W. M.* (p. 60), who inquires for a formula for the preparation of lucifer matches with peroxide of lead, I quote the following from the *Journal de Pharmacie* for September:—

"Dextrine 10 parts, chlorate of potash 75 parts, peroxide of lead 35 parts, iron pyrites 35 parts, water sufficient to make a paste of the proper consistence; the metallic salts must be powdered separately.—*F.*

LABORATORY MEMORANDA.

Estimated sensibility of Arsenic to Certain Tests.—

ARSENIOUS ACID.

	Devergie gives Dilution.	Horsley ditto.
Hydrosulphuric acid	500,000	1,120,000, sensible.
	(too low, *J. H.*)	560,000 very sensible.
Am. nit. silver	400,000	280,000 barely.
	(too high, *J. H.*)	150,000 plainly.
Reinsch's test (*Taylor*)		90,000 only.
" (*Horsley*)		280,000 very strong.
" "		560,000 quite plain.
" "		1,120,0000 sensible.

ARSENIC ACID.

Am. nit. silver	12,000 strong (pink deposit).
"	25,000 ceases.

considerably less sensible to Reinsch's test than arsenious acid.

ANTIMONY.

By Reinsch's process	140,000 times (the limit).
" "	20,000 pretty strong.

John Horsley.

ANSWERS TO CORRESPONDENTS.

A. P. S.—If our young correspondent were better acquainted with the recent literature of chemistry, he would find no difficulty in the terms nitrate of *potassium*, chlorate of *barium*, &c. to which he alludes. These expressions have been adopted by many chemists, especially by those who regard a salt as differing from an acid only by containing a metal (or other basic radical) in place of hydrogen. The formulæ HNO_6, KNO_6 are indeed the simplest ways of writing the nitrate of hydrogen (nitric acid), and the nitrate of potassium, respectively.

With regard to *A. P. S.*'s second query:—Chloride of potassium is not so soluble a salt as he seems to imagine; he has forgotten also, that if in a liquid a larger amount of any salt whatever be produced than the liquid present can dissolve, a precipitate of that salt necessarily occurs.

Y. W.—Mr. R. A. Brooman is a patent agent at 166 Fleet Street.

W. H. F. H. will find the information he requires in Williams'Chemical Manipulations. We will think over the suggestion, which, however, has been partly anticipated by the publication of Dr. Faraday's lectures.

L. G. N. F.—Amateur (Glasgow)—received. Answers next week.

A. Subscriber.—Mr. Dougall's disinfecting powder is composed of carbolate of lime, with sulphite of lime and magnesia.

R. C. P.—The disinfecting property of earth is no doubt principally owing to the humus, a body of variable composition, but of highly absorbant powers.

J. G. F. R.—We know of none; but will inquire.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business* communications to the PUBLISHER, at the Office; 12 and 13 Red Lion Court, Fleet Street, London, E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Various Methods for the Estimation of Copper, by FREDERICK FIELD.

[SECOND PART, *continued from* p. 63.]

C. MOHR precipitates metallic copper from its neutral solution by means of metallic iron.

$$CuO.SO_3 + Fe = FeO.SO_3 + Cu.$$

and estimates the amount of iron in the protosulphate by permanganate of potash. The solution is made very slightly acid, and chloride of sodium added. Too much heat is avoided during precipitation, as basic persalts of iron are thrown down at an elevated temperature. This method, when performed with care, according to Mohr, gives accurate results. I have always met with difficulties in its execution, as an excess of acid, however slight, necessarily gave results too high by an excessive formation of chloride of iron; and when no acid was present basic salts were formed in such a quantity as to yield an apparent loss of copper.

FLEITMANN precipitates the copper by metallic iron in the same manner as Mohr: washes the precipitate, and dissolves in perchloride of iron.

$$Fe_2Cl_3 + Cu = 2\ FeCl + CuCl.$$

The iron is determined, as before, by permanganate of potash. The results are very accurate.

In both the above processes much time and labour are doubtless spent in vain. It is far easier and quite as exact (more so, indeed, than in Mohr's method) to weigh the precipitated copper after washing and drying, if the precautions already advised have been followed, than to redissolve it, and estimate an equivalent of iron. If two equal weights of sulphate of copper, for example, are taken, dissolved in water, acidified, and precipitated by iron; in one case the copper is simply washed, dried, and weighed, and in the other it is redissolved in perchloride of iron, and the protochloride of that metal determined. Both the simple precipitation process and Fleitmann's give equally satisfactory results; but the former has the advantage of being more expeditious and less complicated.

Mohr's process will be seen at once to be perfectly inadmissible in the assay of the great bulk of copper minerals, unless he separates the copper by a preliminary operation, as iron is invariably present.

STRENG'S METHOD.—The oxide of copper is reduced to suboxide by grape sugar, a solution of starch and iodide of potassium added, and afterwards a standard solution of bichromate of potash, until a permanent blue colour is produced.

$$3\ Cu_2O + Cr_2O_6 = 6\ CuO + Cr_2O_3.$$

Dr. Streng takes advantage of the fact that bichromate of potash expels iodine from hydriodic acid, and the former then gives a blue colour with starch paste, in case no reducing substance is present. Thus no permanent blue can be formed as long as any subchloride of copper exists; but when the whole is converted into protochloride by the decomposition of the chromic acid, the blue iodide of starch remains. This method yields accurate results, but caution is required in the addition of the iodide of potassium. Diniodide of copper is excessively insoluble in hydrochloric acid unless the latter be in great excess, so that when a considerable quantity of the alkaline iodide is employed, and little hydrochloric acid is present, there is not much dichloride of copper in solution. The formation of the green sesquichloride of chromium also interferes disagreeably with the blue colour of the iodide of starch, rendering it difficult to tell when that compound is permanently produced. Dr. Streng has proved by many experiments that grape sugar in the cold has little or no reducing power upon bichromate of potash.

LEVAL'S process consists in placing a plate of metallic copper in an ammoniacal solution of oxide of copper until the latter becomes colourless,

$$CuO.NH_4O + Cu = Cu_2O.NH_4O.$$

the loss the copper has sustained corresponding to the quantity of copper originally in solution. The method is exact, but very tedious.

MM. PLESSY and MOREAU form a protochloride of copper as nearly neutral as possible by the addition of ammonia and the subsequent employment of hydrochloric acid, so as just to remove the blue colour and to present the well-known green of chloride of copper; and boiling this solution with a strip of metallic copper until it becomes colourless,—the loss of weight indicates the amount of metal in the chloride.

$$CuCl + Cu = Cu\ 2Cl.$$

In the notice of this method in the *Chemical Gazette*, in one of the numbers for 1859, it is said that iron interferes in the reaction, as metallic copper in solutions of salts of iron and copper reduces the copper to its minimum whilst the iron is at its maximum of oxidation.

This is probably an error of translation, as the reduction of persalts of iron to protosalts by copper is known to every one; and, in fact, one or two processes quoted above depend upon its reducing action.

Mr. E. O. BROWN dissolves the cupreous compound in nitric acid, adds carbonate of soda, and afterwards acetic acid in excess. Iodide of potassium is then added, equal at least to six times the weight of the copper. A standard solution of hyposulphite of soda is poured into the flask from a burette until the brown colour nearly disappears. Clear starch liquid is then introduced, and a further addition of the hyposulphite, until the blue colour is destroyed. This process, which yields most accurate results, fails to do so in the presence of peroxide of iron, not only, as Mr. Brown remarks, on account of the deep colour of peracetate of iron, but more particularly because the peroxide becomes partially deoxidised by the hyposulphite, and thus the reaction is interfered with. The estimation of copper in many alloys, &c. is by this method very rapid and trustworthy.

JACQUELIN has proposed to determine the amount of copper by means of a comparison of the intensity of blue in its ammoniacal solution. A series of tubes are

arranged, containing certain weights of oxide of copper in ammonia, and the blue colours are compared. Although useful in the estimation of copper in slags and other poor metallurgic products, it can hardly be admitted as more than an approximative assay.

Mr. David Forbes (*Jameson's Edinburgh Journal*, 1853) estimates the sulphide of copper obtained by precipitation, by heating it to redness in a crucible, allowing the mass to cool, adding carbonate of ammonia, and again heating. By this means the sulphate of copper formed during the ignition is decomposed, and an oxide and subsulphide remain. As each of these compounds contains equal quantities of copper (Cu_2S=80 % Cu, and CuO=80 % Cu), it does not matter in what proportion they may be formed during the ignition. Mr. Forbes found it impossible to obtain accurate results without the use of carbonate of ammonia, as the sulphuric acid requires an intense heat for its entire expulsion. Mr. Mitchell had years before used carbonate of ammonia in calcining sulphides of copper for the same purpose (see *Manual of Assaying*, 1st edition, 1846), and I have found it extremely advantageous, although its utility is doubted by Mr. J. A. Phillips (see *Metallurgy, Copper Assay*).

Mr. L. Rivot founds a process for the estimation of copper upon the insolubility of the subsulphocyanide of that metal (Cu_2CyS_2), and the great solubility of all other sulphocyanides in acid fluids.

The copper and other metals are obtained in solution in hydrochloric acid, and deoxidised by sulphurous acid or sulphite of soda. A dilute solution of sulphocyanide of potassium is now added, and the precipitate collected, gently dried, and weighed. The determination can be checked by converting the sulphocyanide into disulphide (Cu_2S) by fusion with a little sulphur in a porcelain crucible, from which air is excluded.

In nearly all the determinations above cited, except the process of Mr. Parkes, and in some instances of Pelouze, it is indispensable to free the solution from iron. As this is a very serious obstacle to the facility, and what is of far greater importance, the correctness of the assay, it has been my endeavour to devise a plan whereby copper, although in solution with many other metals, and iron among the number, might be speedily and correctly determined. Cyanide of potassium, it must be remembered, although applicable in many instances, is of little or no service when nickel, cobalt, manganese, zinc, mercury, or silver, are present. When iodide of potassium is added to a solution of a protosalt of copper, it is well known that iodine is eliminated, and diniodide of copper formed; but when iodine is added to a subsalt of copper, the whole of the former unites with the metal, and if a solution of iodide of potassium containing free iodine be added to a cupreous salt, both the free iodine, as well as that in combination, unite with the copper. The least excess is made discernible by a solution of starch. The process, therefore, is simply as follows:—The solution of the compound, free from nitric acid, is thoroughly deoxidised by sulphite of soda, and all excess of sulphurous acid expelled by boiling with hydrochloric acid. When cold, a small quantity of starch water is added, and the ioduretted iodide of potassium poured into the flask from a burette. Diniodide of copper is precipitated, and where the two solutions touch, a bright blue ring is formed, which disappears upon agitation. The process is complete when the blue becomes permanent; the objection is that the diniodide of copper has a great influence upon the iodide of starch, rendering it much paler and more indistinct, and considerable practice is required to ascertain exactly the point when the colour is first produced. By placing the flask upon a sheet of white paper, the bluish shade becomes much more apparent. When a very large quantity of iron is in the compound, the blue colour disappears after some hours, as iodide of starch is decomposed, although very slowly, by protosalts of iron. This does not vitiate the results, however, as the iodine gives no blue (that is to say, no colour which lasts more than a few seconds) until all the copper is precipitated. Although much time has been expended upon the above process, it is submitted with diffidence, inasmuch as the blue tint is not nearly so decided as could be wished, and at present this method can scarcely be recommended as applicable for the estimation of copper. Both silver and mercury would interfere, but they are easily separated; the silver of course would remain as chloride when the compound was dissolved, and the mercury would be precipitated as subchloride upon the addition of sulphite of soda.

In reviewing this brief and rapid sketch of the various methods employed for the estimation of copper, it will appear evident, I think, that much must be left to the knowledge and experience of the manipulator. In a mixture of lead, arsenic, and copper, the cyanide process could be advantageously adopted, whilst the method of precipitation would be worthless, as all the metals would be reduced. Manganese and zinc do not, on the other hand, affect the precipitation of copper upon iron, but render the cyanide estimation valueless.

The writer, ignorant of what substances may be undergoing investigation in the hands of the operator, can but point out the various methods that may be useful. Which will answer his purpose best, the experimentalist must decide.

TECHNICAL CHEMISTRY.

Notices of some of the Patents taken out for the Preparation and use of the new Purple Dyes generally known as the "Mauve or Perkins' Purple, Harmaline, Violine, Purpurine, Roseine, &c." with Remarks upon them.

The superb and fast purple colours obtained by the action of bichromate of potash on aniline and its homologues, was discovered by Mr. W. H. Perkins. Dr. Hofmann's researches on aniline were doubtless the true cause of attention being drawn to that base as a substance from which results of practical importance were one day to be obtained; and in the hands of his pupil, the manufacture of aniline purple has become one of the most refined and beautiful manufactures known.

The tendency of aniline to yield colours when subjected to various processes of oxidation has long been known. Solutions of salts of aniline with the mineral acids when evaporated, generally colour the edges of the basins of a red or blue tint. The power of a solution of bleaching powder to develope a charming purple tint in even the weakest aqueous solution of aniline has for many years been known, and applied in the examination of organic bases as a test for the presence of that alkaloid. This reaction has been seized upon as the foundation of a patent granted to Joshua Taylor Beale and Thomas Nesham Kirkham, dated 13th May 1859. The following quotation from the specification will give a sufficient idea of the nature of the process.

"As examples of some of the more desirable modes of producing the improved dye according to our invention, we

give the following proportions and modes of operating: — We take one measure of aniline water saturated, and add thereto one measure of acetic acid, say of five strengths, and one measure of hypochlorite of lime, of, say, specific gravity 1010. The hypochlorite should be carefully added, in order to admit of producing the particular shades of violet blues required, as shades of varying depth may be produced by increasing or decreasing the proportion of the hypochlorite. After a while the dye will become lilac, and will dye lilac of various intensities, depending on the quantity of hypochlorite of lime and water that may be mixed with the dye. Instead of adding a solution of chlorine or hypochlorite of lime to the liquor, we sometimes pass chlorine gas through the latter, carefully watching the same during the process, in order to arrest the further supply of the gas when the desired effect has been produced on the liquor."

With reference to the above we consider that any process founded upon the action of hypochlorite of lime upon aniline must be of limited application. In the first place the presence of the bleaching powder would render it impossible for the fabric previously dyed with fugitive colours to be passed through the bath. In the next place it would interfere in many cases with the subsequent application of other colours. But there is a more serious difficulty owing to the sparing solubility of aniline in water, consequently the dye will always be in a very dilute state, and totally useless in practice as compared with the highly concentrated solution sold by Mr. Perkins, at 6*l.* the gallon. In the next place even the small quantity of aniline which exists in solution will not be totally converted into dye, so that enormous volumes of fluid, involving correspondingly large vessels will have to be employed to obtain a comparatively minute quantity of dye.

Several patents besides that last mentioned, have been taken out for producing aniline purple. Among the substances used to oxidise the aniline may be mentioned peroxide of lead, peroxide of manganese, and the green manganate of potash.

As regards the manganese and peroxide of lead, there are two patents for the use of these substances. The first, dated 7th May 1859, was granted to Richard Dugdale Kay. The last named patentee takes an acetate, sulphate or hydrochlorate of aniline, with excess of acid, and treats the salt with peroxide of manganese at a temperature of 212° F. until no further precipitate is obtained. The patentee also claims peroxide of lead or chloride of lime as oxidising agents. In this process a precipitate and liquid are obtained, both of which contain colouring matter, the latter is obtained from the precipitate by digestion in dilute sulphuric acid. The liquids are then mixed together, and the colouring matter and manganese precipitated by ammonia. The precipitate is then washed and dried, and the colouring matter extracted by weak alcohol or methylated spirit.

This patent does not give any process for separating the brown or resinous impurities which accompany the colouring matter, except by so reducing the strength of the spirit as to prevent it dissolving the former. We were aware long before seeing this patent that peroxide of manganese could be used for producing the colour, but the experiments made upon the subject by a distinguished Scotch chemist were, as we were informed, by no means satisfactory either as regarded the quantity or quality of the product. If the author of this process can substantiate his claim to the chloride of lime and peroxide of lead processes he plainly takes the wind out of the sails of the patents granted to Beale and Kirkham, on the 13th and David S. Price on the 25th May 1859. The latter chemist in his provisional specification claims peroxide or sesquioxide of manganese, but in his final specification he does not mention the manganese, but confines himself to the lead process. Mr. Price, by oxidising aniline and its homologues with peroxide of lead, prepares three colours which he terms "Violine," "Purpurine," and "Roseine." For these he uses the following proportions of the ingredients: —

Violine. — 1 equivalent of aniline, 2 equivalents of sulphuric acid, 1 equivalent of peroxide of lead.

Purpurine. — 2 equivalents of aniline, 2 equivalents of sulphuric acid, 1 equivalent of peroxide of lead.

Roseine. — 1 equivalent of aniline, 1 equivalent of sulphuric acid, two equivalents of peroxide of lead.

The substances are boiled together and filtered hot. The colouring matters are contained in solution. The two first processes do not convert all the aniline into colouring matter, the last does. It is evident, therefore, that the redness of tint increases with the extent of the oxidation. This is quite in accordance with what has been observed generally with the colours from aniline and its congeners. We must admit that while Price's patent appears the most practical of the three, we do not think his process by any means approaching in value to that due to the talent of Mr. Perkins. It is true that the colours would be yielded of considerable purity, but the expense of the peroxide of lead would be very great, and the yield probably small. Moreover there are considerable difficulties in manipulating with so dense a powder as peroxide of lead. All the machinery for agitation must be strong and kept ceaselessly in motion or so heavy a precipitate would sink to the bottom and produce no result.

The process of Mr. Perkins has none of the disadvantages of any of the others; it is simple, practical, and yields an invariable product. It is true that it is said to require expensive and complex machinery in order to carry it out effectively; but as long as a process contains within itself the elements of success (which we do not think these new patents do), a little expense in the construction of machinery is of comparatively little moment where the final product is so valuable.

Williams's patent is for the use of the green manganate (or, as it is often incorrectly called in commerce, permanganate) of potash as the agent of oxidation. The product when the operation is properly conducted, is unexceptionable in purity and beauty. If the action be too much prolonged the colour is entirely changed, and a beautiful pink or crimson colour results. In fact, according to the specification, a certain amount of the pink colour is always produced. In carrying out this patent, the only thing to be considered is the price of the manganate and the quantity of the product. Upon this point we are not in possession of sufficient information to speak positively.

In using these dyes much depends upon the proper selection of the mordants. Tin is the only metal which has yielded unexceptionable results. The perchloride does very well, but stannate of soda is preferred. In printing, the dye is first mixed with gum, and the coloured mucilage is subsequently stirred up with the desired quantity of albumen. The printed fabric is then steamed in order to fix the colour.

Messrs. W. H. Perkins and Matthew Gray (the former the discoverer of the purple, and the latter the skilful director of the great printing establishment at Dalmonach near Glasgow), have taken out a patent for a new method of mordanting for the purple. They effect this by means of oxide or carbonate of lead. The acetate of lead is first printed on, and the fabric is afterwards

through a bath of ammonia, or an alkaline carbonate. By this means the lead becomes fixed in the fibre of the cloth. The purple dye bath should then yield its colour to the mordanted portions, to the exclusion of the other. But it is found in practice that the patterns printed in this manner are not sharp or well defined. The purple runs into those parts of the cloth which should remain white. To prevent this the goods are washed with soap and water after the fixation of the lead, before subjection to the bath; this clears the whites to some extent, but the patentees sometimes add soap to the bath itself, so as to purify the whites. But if the quantity of soap employed at first to wash the mordanted cloth has been in the proportion of one pound to twenty-five yards of cloth, they do not put any amongst the colour in the bath.

It is evident that this process contains within itself sources of error. By the necessity for soaping after the mordanting it appears that the lead does not adhere with sufficient firmness to the spot where it has been printed on, the soap is therefore to remove the feebly attached portions of mordant and prevent the colour from passing its proper limits. If, however, the first soaping has been insufficiently performed the dye spreads. This can to some extent be avoided by the objectionable process of putting soap into the dye bath. The patentees also put oily or fatty matters into the bath to prevent the spreading of the colour. We have reason to believe that this patent process is not successful in practice.

PHARMACY, TOXICOLOGY, &c.

On the Amount of Cantharidin contained in different Parts of the Body of the Cantharis vesicatoria, by M. Ferrer.[1]

Various opinions have been expressed on the question whether the cantharidin is equally distributed all through the body of the insect, or whether it exists only in certain parts to the exclusion of the others. Pliny, Galen, and Aetius believed that the elytra had no action. Hippocrates recommended that the head with its antennæ, the elytra, the membranous wings, and legs should be rejected, as he considered them completely inert. This opinion was adopted by Schwilgué in the third edition of his *Materia Medica*, which appeared in 1818. Latreille, Cloquet, and Audoin, on the contrary, assert that all parts of the body contain cantharidin.

In 1826, M. Farines, a pharmacien at Perpignan, having tried, without effect, plasters prepared separately with the powder of the elytra, wings, antennæ, and legs, returned to the opinion of Hippocrates, and in a note addressed to the Société de Pharmacie of Paris laid down the following conclusions:—

1. That the active part resided only in the soft organs.
2. That the hard organs do not possess any vesicating power.

In 1855, M. Courbon, in a memoir presented to the academy, also said that the vesicating principle of cantharides resided only in the soft or internal parts; but in opposition to M. Farines he contended that the soft parts of all regions possessed a vesicating property: that the soft or internal parts of the legs and head are as active as those of the thorax and abdomen, and that the only parts of the body completely inert are the elytra, the antennæ, and the portions of the feet composed only of hard parts.

[1] *Répertoire de Pharmacie.*

In 1856, M. Berthoud sought chemically for cantharidine: 1, in the abdomen and thorax, which he designated the *soft parts* of the flies; and 2, in the elytra, wings, antennæ, and feet, which he called the horny parts:

250 grammes of the abdomen and thorax gave 0·45 of cantharidin.

125 grammes of the horny parts gave 0·053.

These results, completely opposed to the conclusions of M. Farines, do not, however, demonstrate the existence of cantharidin in every part of the body of the fly. They only serve to confirm the opinion and the observations of M. Courbon. The parts which M. Berthoud has named collectively the horny parts, and from which he has extracted the cantharidin, contain in their interior a certain quantity of soft parts (the soft parts of the head and legs) and the cantharidin might be obtained exclusively from these soft parts if the observations of M. Courbon were strictly true.

On a question so interesting and as it appeared to me so imperfectly resolved, I thought it would be useful to make some new researches. To ascertain whether cantharidin is indifferently distributed over every part of the body, or whether it is only contained in particular parts, I have sought for it;—1, in the feet and legs; 2, in the head; 3, in the elytra and wings; and 4, in the thorax and abdomen.

First experiment:—11 grammes of the feet and legs were powdered and treated in a displacement apparatus with 25 grammes of chloroform; after macerating for three days the liquid was run off and the chloroform displaced by means of alcohol. The chloroform so obtained was allowed to evaporate in the air, and the residue was placed between folds of blotting paper to absorb the oil. The crystals left were redissolved in a small quantity of chloroform, again crystallised and then weighed. From the 11 grammes of the feet, 0·01 of cantharidin was obtained, still stained with a little of the green oil.

Second experiment:—17 grammes of the head and antennæ (there were very few antennæ) were treated with 35 grammes of chloroform, like the preceding, and from them 0·015 of cantharidin was obtained.

Third experiment:—11 grammes of the elytra and membranous wings were treated with 25 grammes of chloroform, and yielded 0·009 of cantharidin.

Fourth experiment:—30 grammes of the thorax and abdomen were mixed in a displacement apparatus with 70 grammes of chloroform. In this experiment the residue obtained by the spontaneous evaporation of the chloroform, furnished a large quantity of crystals. After having absorbed the oil and redissolved the crystals in a small quantity of chloroform, I threw the solution on a filter. After filtration I opened the paper and found it covered with small micaceous crystals of cantharidin perfectly white. The chloroform had deposited the crystals as it evaporated, and the green oil had passed through with the chloroform which had not evaporated. As this last portion might still contain a small quantity of cantharidin, I evaporated and again dissolved it in a little chloroform, and threw it on a filter as before. After repeating this a third time I obtained all the cantharidin furnished by the 30 grammes of the thorax and abdomen perfectly white. It weighed 0·072 grammes.

The blisters produced on my arm by a very small quantity of the crystals obtained in my experiments, left no doubt of their nature. From these experiments the author draws the conclusion that the active principle of cantharides is found distributed over all parts of the body.

A New Method of preparing the Fer Réduit.

A process invented by M. D. Guicciardi[1] consists in precipitating a concentrated solution of pure sulphate of iron with a hot saturated solution of oxalic acid. The precipitated oxalate is then placed in a gun barrel and gently heated, and afterwards a constant current of dry hydrogen is passed. Towards the end of the operation the gun barrel must be brought to a cherry-red heat. Before removing the powder it must be allowed to get quite cold. Prepared in this way, the *fer réduit* is a light, blackish-grey powder, which quickly dissolves in water acidulated with sulphuric acid, and takes fire, becoming changed into oxide, under the influence of heat.

[1] *Répertoire de Pharmacie*, Déc. 1859.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures[1] *(adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i. e. of such as are called the Physical or Inorganic Forces — including an Account of their Relations to each other; by* M. Faraday, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R. I., Foreign Associate of the Academy of Sciences, Paris, &c.*

Lecture III. (Jan. 4, 1860.) *Cohesion—Chemical Affinity.*

We will first of all return for a few minutes to one of the experiments which we made yesterday. You remember what we put together on that occasion?—Powdered alum and warm water; here is one of those basins; nothing has been done to it since then, but you will find on examining it that it no longer contains any powder, but a multitude of beautiful crystals. Here also are the pieces of coke which I put into the other basin, these have a fine mass of crystals about them. That other basin I will leave as it is; I will not pour the water from it, because it will show you that the particles of alum have done something more than merely crystallise together. They have pushed the dirty matter from them, laying it around the outside or outer edge of the lower crystals—squeezed out as it were by the strong attraction which the particles of alum have for each other.

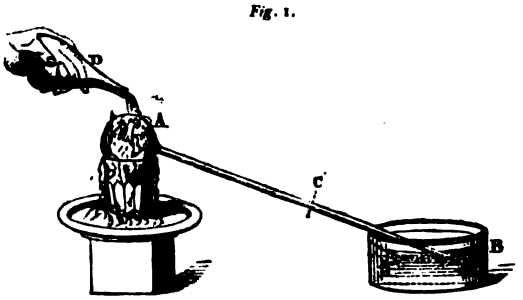
And now for another experiment. We have already gained a knowledge of the manner in which the particles of bodies—of solid bodies—attract each other, and we know that it makes calcareous spar, alum, and so forth, crystallise in these regular forms. Now let me gradually lead your minds to a knowledge of the means we have of making this attraction alter a little in its force; either of increasing, or diminishing, or apparently of destroying it altogether. I will take this piece of iron [a rod of iron about two feet long and a quarter of an inch in diameter], it has at present a great deal of strength, due to its attraction of cohesion; but if Mr. Anderson will make part of this rod hot in the fire, we shall then find that it will become soft, just as sealing-wax will when heated, and we shall also find that the more it is heated the softer it becomes. Ah! but what does *soft* mean? Why, that the attraction between the particles is so weakened that it is no longer sufficient to resist the power we bring to bear upon it. [Mr. Anderson handed to the Lecturer the iron rod, with one end red-hot, which he showed could be easily twisted aboutwith a pair of pliers.] You see, I now find no difficulty in bending this end about how I like; whereas I cannot bend the cold part at all. And you know how the smith takes a piece of iron and heats it, in order to render it soft for his purpose: he acts upon our principle of lessening the adhesion ofthe particles, although he does not know exactly the terms in which we express it.

And now we have another point to examine; and this water is again a very good substance to take as an illustration (as philosophers we call it all water, even though it be in the form of ice or steam). Why is this water hard? [pointing to a block of ice] because the attraction of the particles to each other is sufficient to make them retain their place in opposition to force applied to it. But what happens when we make the ice warm? Why, in that case we diminish to such a large extent the power of attraction that the solid substance is destroyed altogether. Let me illustrate this: I will take a red-hot ball of iron [Mr. Anderson by means of a pair of tongs handed to the Lecturer a red-hot ball of iron, about two inches diameter] because it will serve as a convenient source of heat [placing the red-hot iron in the centre of the block of ice]. You see I am now melting the ice where the iron touches it. You see the iron sinking into it, and while part of the solid water is becoming liquid, the heat of the ball is rapidly going off. A certain part of the water is actually rising in steam—the attraction of some of the particles is so much diminished that they cannot even hold together in the liquid form, but escape as vapour. At the same time you see I cannot melt all this ice by the heat contained in this ball. In the course of a very short time I shall find it quite cold.

Here is the water which we have produced by destroying some of the attraction which existed between the particles of the ice, for below a certain temperature the particles of water increase in their mutual attraction and become ice; and above a certain temperature the attraction decreases and the water becomes steam. And exactly the same thing takes place with platinum, and nearly every substance in nature; if the temperature is increased to a certain point it becomes liquid, and a further increase makes it a gas. Is it not a glorious thing for us to look at the sea, the rivers, and so forth, and to know that this same body in the northern regions is all solid ice and ice-bergs, while here in a warmer climate it has its attraction of cohesion so much diminished as to be liquid water. Well, in diminishing this force of attraction between the particles of ice, we made use of another force, namely, that of *heat*, and I want you now to understand that this force of heat is always concerned when water passes from the solid to the liquid state. If I melt ice in *other* ways I cannot do without heat; (for we have the means of making ice liquid without heat; that is to say, without using heat as a *direct* cause). Suppose, for illustration, I make a vessel out of this piece of tin foil [bending the foil up into the shape of a dish]. I am making it metallic, because I want the heat which I am about to deal with to pass readily through it;—and I am going to pour a little water on this board, and then place the tin vessel on it. Now if I put some of this ice into the metal dish, and then proceed to make it liquid by any of the various means we have at our command, it still must take the necessary quantity of heat from something, and in this case it will take the heat from the tray, and from the water underneath, and from the other things round about. Well, a little salt added to the ice, has the power of causing it to melt, and we shall very shortly see the mixture become quite fluid, and you will then find that the water beneath will be frozen—frozen because it has been forced to give up that heat which is necessary to keep it in the liquid state, to the ice on becoming liquid. I remember once, when I was a boy, hearing of a trick in a country alehouse; the point was how to melt ice in a quart pot by the fire, and freeze it to the stool. Well, the way they did it was this: they put some pounded ice in a pewter pot and added some salt to it, and the consequence was that when the salt was mixed with it the ice in the pot melted (they did not tell me anything about the salt, and they set the pot by the fire, just to make the result more mysterious), and in a short time the pot and the stool were frozen together, as we shall very shortly find it to be the case here, and all because salt has the power of lessening the attraction between the particles of ice. Here you see the tin dish is frozen to the board, I can even lift this little stool up by it.

This experiment then cannot, I think, fail to impress upon your minds the fact, that whenever a solid body loses some of that force of attraction by means of which it remains solid, heat is absorbed; and if, on the other hand, we convert a liquid into a solid, *e. g.* water into ice, a corresponding amount of heat is given out. I think an experiment of this kind will serve to show you this. Here (*fig.* 1.) is a bulb A, filled with air, the tube from which dips into some coloured liquid in the vessel B. And I

Fig. 1.

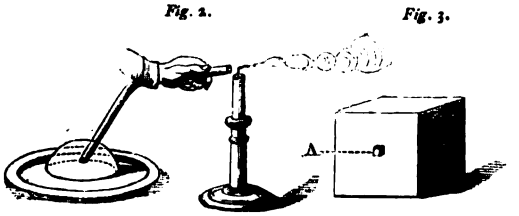


[1] Reported verbatim by special permission.

dare say you know that if I put my hand on the bulb A, and warm it, the coloured liquid which is now standing in the tube at C will travel forward. Now we have discovered a means, by great care and research into the properties of various bodies, of preparing a solution of a salt which if shaken or disturbed will at once become a solid; and as I explained to you just now (for what is true of water is true of every other liquid), by reason of its becoming solid, heat is evolved, and I can make this evident to you by pouring it over this bulb;—there! it is becoming solid, and look at the coloured liquid, how it is being driven down the tube, and how it is bubbling out through the water at the end; and so we learn this beautiful law of our philosophy, that whenever we diminish the attraction of cohesion we absorb heat—and whenever we increase that attraction heat is evolved. This then is a great step in advance, for you have learned a great deal in addition to the mere circumstance that particles attract each other. But you must not now suppose that because they are liquid they have lost their attraction of cohesion; for here is the fluid mercury, and if I pour it from one vessel into another I find that it will form a stream from the bottle down to the glass—a continuous rod of fluid mercury, the particles of which have attraction sufficient to make them hold together all the way through the air down to the glass itself: and if I pour water quietly from a jug I can cause it to run in a continuous stream in the same manner. Again, let me put a little water on this piece of plate glass, and then take another plate of glass and put it on the water; there! the upper plate is quite free to move, gliding about on the lower one from side to side; and yet, if I take hold of the upper plate and lift it up straight, the cohesion is so great that the lower one is held up by it. See how it runs about it as I move the upper one, and this is all owing to the strong attraction of the particles of the water. Let me show you another experiment. Suppose I take a little soap and water—not that the soap makes the particles of the water more adhesive one for the other, but it certainly has the power of continuing in a better manner the attraction of the particles; (and let me advise you, when about to experiment with soap bubbles to take care to have everything clean and soapy). I will now blow a bubble, and that I may be able to talk and blow a bubble too, I will take a plate with a little of the soapsuds in it, and will just soap the edges of the pipe, and blow a bubble on to the plate. Now, there is our bubble. Why does it hold together in this manner? Why, because the water of which it is composed has an attraction of particle for particle:—so great, indeed, that it gives to this bubble the very power of an india-rubber ball; for you see, if I introduce one end of this glass tube into the bubble that it has the power of contracting so powerfully as to force enough air through the tube to blow out a light (*fig.* 2.)—there is a light blown out. And look! see how the bubble is disappearing, see how it is getting smaller and smaller.

There are twenty other experiments I might show you to illustrate this power of the cohesion of the particles of liquids. For instance, what would you propose to me if, having lost the stopper out of this alcohol bottle, I should want to close it speedily with something near at hand. Well, a bit of paper would not do, but a piece of linen cloth would, or some of this cotton wool which I have here. I will put a tuft of it into the neck of the alcohol bottle, and you see when I turn it upside down, that it is perfectly well stoppered so far as the alcohol is concerned; the air can pass through but the alcohol cannot. And if I were to take an oil vessel this plan would do equally well, for in former times they used to send us oil from Italy in flasks stoppered only with cotton wool (at the present time the cotton is put in after the oil has arrived here, but formerly it used to be sent so stoppered.) Now if it were not for the particles of

Fig. 2. *Fig.* 3.



liquid cohering together, this alcohol would run out, and if I had time I could have shown you a vessel with the top, bottom and sides altogether formed like a sieve, and yet it would hold water owing to this cohesion.

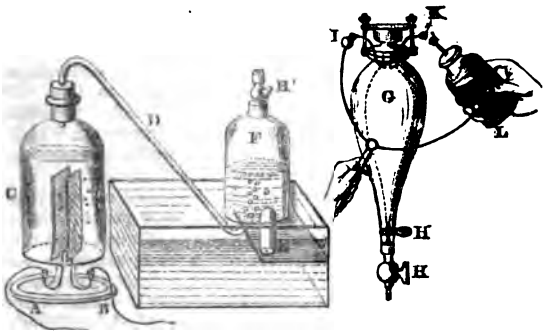
You have now seen that the solid water can become fluid by the addition of heat, owing to this lessening the attractive force between its particles, and yet you see that there is a good deal of attractive force remaining behind. I want now to take you a step beyond that. We saw that if we continued applying heat to the water (as indeed happened with our piece of ice here) that we did at last break up that attraction which holds the liquid together, and I am going to take some ether (any other liquid would do, but ether makes a better experiment for my purpose,) in order to illustrate what will happen when this cohesion is broken up. Now this liquid ether, if exposed to a very low temperature, will become a solid, but if we apply heat to it, it becomes vapour, and I want to show you the enormous bulk of the substance in this new form:—when we make ice into water, we lessen its bulk, but when we convert water into steam, we increase it to an enormous extent. You see it is very clear that as I apply heat to the liquid I diminish its attraction of cohesion—it is now boiling, and I will set fire to the vapour, so that you may be enabled to judge of the space occupied by the ether in this form by the size of its flame, and you now see what an enormously bulky flame I get from that small volume of ether below. The heat from the spirit lamp is now being consumed, not in making the ether any warmer, but in converting it into vapour, and if I desired to catch this vapour and condense it (as I could without much difficulty), I should have to do the same as if I wished to convert steam into water and water into ice: in either case it would be necessary to increase the attraction of the particles, by cold or otherwise. So largely is the bulk occupied by the particles increased by giving them this diminished attraction, that if I were to take a portion of water a cubic inch in bulk (A *fig.* 3.) I should produce a volume of steam of that size B [1700 cubic inches; nearly a cubic foot], so greatly is the attraction of cohesion diminished by heat; and yet it still remains water. You can easily imagine the consequences which are due to this change in volume by heat—the mighty powers of steam and the tremendous explosions which are sometimes produced by this force of water. I want you now to see another experiment which will perhaps give you a better illustration of the bulk occupied by a body when in the state of vapour. Here is a substance which we call iodine, and I am about to submit this solid body to the same kind of condition as regards heat that I did the water and the ether [putting a few grains of iodine into a hot glass globe, which immediately became filled with the violet vapour], and you see the same kind of change produced. Moreover, it gives us the opportunity of observing how beautiful is the violet-coloured vapour from this black substance, or rather the mixture of the vapour with air (for I would not wish you to understand that this globe is entirely filled with the vapour of iodine).

If I had taken mercury and converted it into vapour (as I could easily do), I should have a perfectly colourless vapour, for you must understand this about vapours, that bodies in what we call the vaporous, or the gaseous state, are always perfectly transparent, never cloudy or smoky; they are however often coloured, and we can frequently have coloured vapours or gases produced by colourless particles themselves mixing together, as in this case [the Lecturer here inverted a glass cylinder full of binoxide of nitrogen over a cylinder of oxygen, when the dark red vapour of hyponitric acid was produced]. Here also you see a very excellent illustration of the effect of some power of nature which we have not yet come to, but which stands next on our list—Chemical Affinity. And thus you see we can have a violet vapour or an orange vapour, and different other kinds of vapour, but they are always perfectly transparent, or else they would cease to be vapours.

I am now going to lead you a step beyond this consideration of the attraction of the particles for each other. You see we have come to understand that (to take water as an illustration) whether it be ice, or water, or steam, it is always to be considered by us as water. Well, now prepare your minds to go a little deeper into the subject. We have means of searching into the constitution of water beyond any that are afforded us by the action of heat, and among these one of the most important is that force which we call voltaic electricity, which we used at our last meeting for the purpose of obtaining light, and which we carried about the room by means of these wires. This force is produced by the battery behind me, to which however I will not now refer more particularly; before we have done we shall know more about this battery, but it must grow up in our knowledge. Now here (*fig.* 4.) is a portion of water in this little vessel C, and besides the water there are two plates of the metal platinum, which are connected with the wires (A and B) coming outside, and

I want to examine that water, and the state and the condition in which its particles are arranged. If I were to apply heat to it you know what we should get, it would assume the state of

Fig. 4

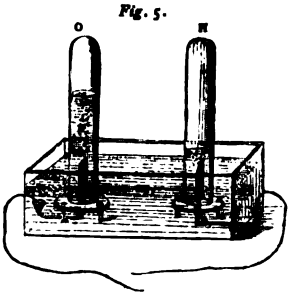


vapour, but it would nevertheless remain water, and would return to the liquid state as soon as the heat was removed. Now by means of these wires (which are connected with the battery behind me, and come under the floor and up through the table) we shall have a certain amount of this new power at our disposal. Here you see it is [causing the ends of the wires to touch]—that is the electric light we used yesterday, and by means of these wires we can cause water to submit itself to this power; for the moment I put them into metallic connexion (at A and B) you see the water boiling in that little vessel (C) and you hear the bubbling of the gas that is going through the tube (D). See how I am converting the water into vapour, and if I take a little vessel (E), and fill it with water, and put it in the trough over the end of the tube (D), there goes the vapour ascending into the vessel. And yet that is not steam, for you know that if steam is brought near cold water, it would at once condense, and return back again to water; this then cannot be steam, for it is bubbling through the cold water in this trough, but it is a vaporous substance, and we must therefore examine it carefully, to see in what way the water has been changed. And now in order to to give you a proof that it is not steam, I am going to show you that it is combustible, for if I take this small vessel to a light, the vapour inside explodes in a manner that steam could never do.

I will now fill this large bell-jar (F) with water; and I propose letting the gas ascend into it, and I will then show you that we can reproduce the water back again from the vapour or air that is there. Here is a strong glass vessel (G), and into it we will let the gas (from F) pass. We will then fire it by the electric spark, and then after the explosion you will find that we have got the water back again; it will not be much however, for you will recollect that I showed you how small a portion of water produced a very large volume of vapour. Mr. Anderson will now pump all the air out of this vessel (G), and when I have screwed it on to the top of our jar of gas (F), you will see upon opening the stopcocks (H' H H) the water will jump up, showing that some of the gas has passed into the glass vessel. I will now shut these stopcocks, and we shall be able to send the electric spark through the gas by means of the wires (I, K) in the upper part of the vessel, and you will see it burn with a most intense flash. [Mr. Anderson here brought a Leyden jar, which he discharged through the confined gas by means of the wires I, K.] You saw the flash, and now that you may see that there is no longer any gas remaining, if I place it over the jar and open the stopcocks again, up will go the gas, and we can have a second combustion; and so I might go on again and again, and I should continue to accumulate more and more of the water to which the gas has returned. Now is not this curious;—in this vessel (C) we can go on making from water a large bulk of *permanent gas*, as we call it, and then we can reconvert it into water in this way. [Mr. Anderson brought in another Leyden jar, which, however, from some cause would not ignite the gas. It was therefore recharged, when the explosion took place in the desired manner.] How beautifully we get our results when we are right in our proceedings!—it is not that Nature is wrong when we make a mistake. Now I will lay this vessel (G) down by my right hand, and you can examine it by and by: there is not very much water flowing down, but there is quite sufficient for you to see.

Another wonderful thing about this mode of changing the condition of the water is this—that we are able to get the separate parts of which it is composed, at a distance the one from the other, and to examine them, and see what they are like, and how many of them there are; and for this purpose I have here some more water in a slightly different apparatus to the former one (*fig.* 5.), and if I place this in connection with the wires of the battery (at A B) I shall get a similar decomposition of the water at the two platinum plates. Now I will put this little tube (O) over there, and that will collect the gas together that comes from this side (A), and this tube (H) will collect the gas that comes from the other side (B) and, I think we shall soon be able to see a difference. In this apparatus, the wires are a good way apart from each other, and it now seems that *each* of them is capable of drawing off particles from the water and sending them off, and you see that one set of particles (H) is coming off twice as fast as those collected in the other tube (O). Something is coming out of the water *there* (at H) which burns [setting fire to the gas], but what comes out of the water *here* (at O), although it will not burn, will support combustion very vigorously. [The Lecturer here placed a match with a glowing tip in the gas, when it immediately rekindled.]

Fig. 5.



Here then we have two things, neither of them being water alone, but which we get out of the water. Water is therefore composed of two substances different to itself, which appear at separate places when it is made to submit to the force which I have in these wires, and if I take an inverted tube of water and collect this gas (H), you will see that it is by no means the same as the one we collected in the former apparatus (*fig.* 4.). That exploded with a loud noise when it was lighted, but this will burn quite noiselessly—it is called *hydrogen*; and the other we call *oxygen*—that gas which so beautifully brightens up all combustion, but does not burn of itself. So now we see that water consists of two kinds of particles attracting each other in a very different manner to the attraction of gravitation or cohesion, and this new attraction we call *chemical affinity*, or the force of chemical action between different bodies; we are now no longer concerned with the attraction of iron for iron, water for water, wood for wood, or like bodies for each other as we were when dealing with the force of cohesion; we are dealing with another kind of attraction,—the attraction between particles of a *different* nature one to the other. Chemical affinity depends entirely upon the energy with which particles of *different* kinds attract each other. Oxygen and hydrogen are particles of different kinds, and it is their attraction to each other which makes them chemically combine and produce water.

I must now show you a little more at large what chemical affinity is. I can prepare these gases from other substances as well as from water; and we will now prepare some oxygen: here is another substance which contains oxygen—chlorate of potash; I will put some of it into this glass retort, and Mr. Anderson will apply heat to it: we have here different jars filled with water, and when by the application of heat the chlorate of potash is decomposed, we will displace the water, and fill the jars with gas.

Now when water is opened out in this way by means of the battery; which adds nothing to it materially, which takes nothing from it materially (I mean no *matter*, I am not speaking of *force*); which adds no *matter* to the water; it is changed in this way—the gas which you saw burning a little while ago, called *hydrogen*, is evolved in large quantity, and the other gas, *oxygen*, is evolved in only half the quantity, so that those two areas

1 Hydrogen	8 Oxygen	Oxygen . . . . . 88·9
		Hydrogen . . . . . 11·1
	9	Water . . . . . 100·0

represent water, and those are always the proportions between the two gases. But oxygen is sixteen times the

other — eight times as heavy as the particles of hydrogen in the water; and you therefore know that water is composed of nine parts by weight — one of hydrogen and eight of oxygen, thus:

Hydrogen . . .	46·2 cubic inches . .	= 1 grain.
Oxygen . . .	23·1 „ „ . .	= 8 grains.
Water . . (*steam*)	69·3 „ „ . .	= 9 grains.

Now Mr. Anderson has prepared some oxygen, and we will proceed to examine what is the character of this gas. First of all you remember I told you that it does not burn, but that it affects the burning of other bodies. I will just set fire to the point of this little bit of wood, and then plunge it into the jar of oxygen, and you will see what this gas does in increasing the brilliancy of the combustion. It does not burn, it does not take fire as the hydrogen would, but how vividly the combustion of the match goes on. Again, if I were to take this wax taper and light it, and turn it upside down in the air, it would in all probability put itself out, owing to the wax running down into the wick. [The Lecturer here turned the lighted taper upside down, when in a few seconds it went out.] Now that will not happen in oxygen gas; you will see how differently it acts (*fig.* 6.) [The taper was again lighted, turned upside down, and then introduced into a jar of oxygen.] Look at that! see how the very wax itself burns, and falls down in a dazzling stream of fire, so powerfully does the oxygen support combustion. Again, here is another experiment which will serve to illustrate the force, if I may so call it, of oxygen. I have here a circular flame of spirit of wine, and with it I am about to show you the way in which iron burns, because it will serve very well as a comparison between the effect produced by air and oxygen. If I take this ring flame, I can shake by means of a sieve the fine particles of iron filings through it, and you will see the way in which they burn. [The Lecturer here shook through the flame some iron filings which took fire and fell through with beautiful scintillations.] But if I now hold the flame over a jar of oxygen [the experiment was repeated over a jar of oxygen, when the combustion of the filings as they fell into the oxygen became almost insupportably brilliant], you see how wonderfully different the effect is in the jar, because there we have oxygen instead of common air.

Fig. 6.

(*The Fourth Lecture, on* Chemical Affinity *and* Heat, *will appear in our next.*)

NOTICES OF BOOKS, PATENTS, &c.

Letters on Modern Agriculture, by Baron Von Liebig. *Edited by* John Blyth, *M.D. Professor of Chemistry, Queen's College, Cork.*

On the Valuation of Soils, and the Nutrition of Plants, by Robert Galloway, *F.C.S. Professor of Practical Chemistry, Museum of Irish Industry.*

Hints to Practical Agriculturists, by E. B. Fowler.

Notwithstanding the large circulation for some years of works on agricultural chemistry, we believe that an intelligent knowledge of the subject has extended very little among the class whose especial business it immediately concerns. Nor have we far to look for the reason. Agriculture has been for centuries a mere empirical art, with which true scientific knowledge has had nothing whatever to do. Farmers have dug, and ploughed, and manured, simply because their fathers did so, and without troubling themselves in the least about the why and the wherefore. And the system has always answered to a certain extent. But conducted on such a plan, it is clear that agriculture could make no decided advance.

"The progress of every trade by mere empirical experience," says Liebig, "and also of that of agriculture, has a limit. Every experimental method comes to an end when the senses are no longer sufficient for the perception of facts; when no new circumstance is presented to the senses for perception; when in fact every thing has been tried, and the facts resulting from such trials have been adopted into the particular art or trade. Further progress can then only be looked for, if hidden facts are sought out, the senses are sharpened for their perception, and the means of investigation are improved."

But when the chemist comes with his improved means of investigation, he brings with him a science with which the farmer has no acquaintance; he employs a terminology to which a farmer can attach only the vaguest of meanings, and which is at times altogether unintelligible to him. No wonder then that the practical agricultural intellect sometimes looks on the chemist as a charlatan — a reputation which it must be confessed has been at times too well deserved. And yet nothing can be clearer than that if agriculture is to advance, it must be mainly by the assistance of chemistry. Deep drainage, deep ploughing, and more perfect disintegration of the soil, have been productive of much good; but the advantage of these processes has a limit which is soon reached. The fertility of the soil must ultimately depend on the supply of food for the plant grown upon it — that is upon the manure — and how can this be supplied intelligently without knowing, first what the plant requires, and then in what ingredients the soil is deficient.

But here unfortunately the chemist is soon at fault.

"Our knowledge," says Professor Galloway, "at the present time is very crude and limited in all that relates to soils, whether as to their capabilities or requirements; we do not know in what state the substances available for growing plants exist in soils; what the relative proportions, and in what amount must these plant-forming substances be present in order that the land may yield the greatest increase at the least cost. We are yet in doubt whether plants take up the mineral ingredients from the land in a fluid or a solid state. And we have yet to learn the chemical changes which take place between the soil constituents and the manurial substances when the latter are applied to the land. We can learn by the aid of chemical analysis whether a soil contains all the substances required by plants; but this is all the aid which chemistry affords us as regards soils. For if the analysed soil contain all the essential substances, the analysis conveys to us no information as regards the productive power of that soil. If it should prove fertile, we cannot in the majority of cases learn from the analysis upon what its fertility depends; if, on the other hand, it prove barren, whether it is its chemical or physical properties which require to be altered in order to render it fruitful."

It must not be imagined, however, that we are likely to remain long in this state of ignorance. No chemists of the present day are more active than those who devote themselves to the study of agricultural chemistry—not in the laboratory only — but in the fields where alone practical truth is to be acquired.

How much chemistry has done for agriculture up to the present time is a debateable point. Most practical farmers, we believe, would say with Mr. Pusey, that it has done nothing but give a receipt for increasing the efficacy of bones by the action of sulphuric acid, and proposing to employ flax water instead of liquid manure; and they would probably agree with the same gentleman that "it is utterly absurd to put any value on the doubtful precepts of chemistry." Baron Liebig's first letter too reads like a confession of failure, the blame of which, however, he is anxious to throw on the farmer. But if chemical science had done nothing more than point out the value of guano, it would have achieved a great work. We believe that it has already done much, and will do more; and that the time will soon come when the chemist will be the daily adviser of the farmer, as he is of the calico printer, the dyer, the gas manufacturer, and the brewer. In the meantime much has to be accomplished which we may safely leave to those engaged in the study.

Mr. Fowler's *Hints* contain some good advice for farmers; but some of his views have probably been modified since he published his little book. Professor Galloway's well-written paper is a valuable contribution, and we should be glad to see it published so that it may become better known. Liebig's letters have been extensively read, though we fear by che-

mists and amateurs, rather than practical agriculturists. It is gratifying to find that in this book the Baron does not advertise his patent manures.

In conclusion we cannot help quoting from the letters for the benefit of our medical readers the story of the "green" doctor of Offenbach, to whom, it must be premised, Liebig compares the practical agriculturist commencing his career.

"He was a Jewish physician of renown, who was called in to all dangerous cases of illness in Frankfort, Hanau, and the neighbourhood; and his practice was not without success. Nature had given him a quick eye and fine powers of observation. His knowledge was obtained in an hospital in which he acted as sick attendant. He used to accompany the physician through the sick wards, looked at the tongues and urine of the patients after him, felt their pulse, and superintended the orders about their diet. He copied the prescriptions regularly; marked them with a red cross when the patient recovered, and with a black one when he died. His sheets grew by degrees to the size of a book, and when nothing new presented itself to be added to it, he begun in the first instance to practice on a small scale, and then started on the full career of a physician. He was skilled in diagnosis, and had his prescriptions for the various cases. Those with the red crosses came first; and if unsuccessful, then followed the black. In this way he acquired his own experience. He was very orthodox, and on the Sabbath day would write no prescription, but would then dictate them in the apothecary's shop to the assistant. He commenced with 'Rrrrr' (this meant recipe, '*Tartaremet*, two grains' (*i. e.* tartari emetici grana duo); *syralth* (*i. e.* syrupus althese). He could not read h is own prescriptions, but his fame as a practical physician was so established that the regularly educated physicians in Offenbach could not succeed in putting an end to his career on the ground of his never having received a medical education."

Improvements in the Manufacture of Umbrellas, Parasols, Hats or Hat Covers, Caps, Capes, Coats, Mantles, Dresses, Gloves, and other similar articles. Stephen Barnwell and Alexander Rollason, 1859.

Collodion and castor oil have received a new application. Messrs. Barnwell and Rollason use the mixture for making silks and other woven fabrics waterproof. Their manner of proceeding is as follows:—"Assuming the material under operation to be silk, we take collodion and mix it with vegetable oil, such as either hempseed, rape, olive, almond, nut, poppy, castor, cotton, or linseed oil in the purest possible state, and we find that such oils when mixed with collodion undergo a change upon being subjected to heat, and this change or decomposition is highly advantageous in the subsequent processes to which the silk will be applied. The mixture of collodion and oil is spread or poured upon plates or cylinders of metal or glass, and before it is quite set the silk is laid or rolled over it and immediately removed, bringing away with it a thin film of collodion and oil. The silk thus coated is now removed to a stove or drying oven and submitted to a heat of 100° to 300° Fahrenheit, by which the mixture undergoes the before named change or decomposition, and the result is that a slightly glazed appearance is imparted to the silk, which is at the same time considerably strengthened or thickened, and may be rendered almost or quite opaque by the mixture of colouring or thickening matter with the collodion and oil. A thin silk is thus rendered equal in strength to a more costly one, and the quality of imperviousness to water, which the material possesses in a high degree, will be of service."

The patentees prepare their collodion with gun cotton or with xyloidine made from hemp, flax, jute, straw, sawdust, or starch, which they dissolve in any of the solvents of gun cotton and mix with any of the oils before mentioned, adding only so much of the oil or mixed oils as will be freely taken up by the solution. If they desire the coated silk or other fabric to be soft and pliable in its nature, they add a small quantity of animal oil to the solution. The proportions the patentees use for coating silk are 30 parts of the xyloidine dissolved in *about* 300 parts by weight of ether, with 100 parts of spirits of wine, with which is mixed from 75 to 100 parts of vegetable oils. This solution is allowed to evaporate in a still until it arrives at such a density that it will only just flow evenly over a glass plate, so as finally to leave a substantial film behind it.

If the patentees can make some light and inexpensive fabric waterproof, and at the same time soft and pliable, it would be extensively used by surgeons. Oiled silk is expensive, and the oiled calico and gutta percha tissue, sometimes used in its stead, lack the softness and pliability desired. The article we have suggested is greatly desired in our large hospitals.

Improvements in the preparations of certain colouring matters. R. D. Kay, 1859.

The patents for aniline dyes multiply very fast. The inventor of the present process mixes the aniline or similar product with an acid so as to form a salt, the base of which is the aniline or other similar material. An excess of acid is found better than a neutral proportion, and good results are obtained from acetic, hydrochloric, and sulphuric acids. When the last is used, 50 parts of aniline are mixed with 40 parts of the acid (sp. gr. 1·85) diluted with about 1400 parts of water. To this compound 200 parts of peroxide of manganese is added, and the whole is heated to 212° Fahr., and stirred until a precipitate is no longer produced.

The coloured solution is separated from the precipitate by filtration, and the precipitate is digested with more dilute sulphuric acid to dissolve any colouring matter it may contain. Ammonia is then added to the combined solutions to neutralise all the acid and precipitate the colouring matter and manganese. This precipitate is washed and dried, and the colouring matter is dissolved out with alcohol or methylated spirit. The inventor gives the name of *hurmaline* to the colouring matter. The process may be shortened by adding the alkali to the whole solution after the oxidation of the peroxide of manganese has been completed; but in this case the colouring matter must be extracted from the precipitate with alcohol diluted with about three parts of water to avoid dissolving the resinous or bituminous matter which may be mixed with it.

CORRESPONDENCE.

The Atomic Theory.

To the Editor of the Chemical News.

Sir,—The atomic theory has already been the subject of some dispute: still I venture to draw attention to it, because it appears to me to be to some extent inconsistent with itself; and it can scarcely be desirable that a false theory should hold ground, even though it may serve to explain some phenomena easily, because it might have a tendency to warp our ideas of the nature of matter, and it must be allowed that an easy explanation is dearly bought, if it be at the expense of truth.

In the atomic theory it is assumed that matter is not indefinitely divisible, but that, after a certain point, further division becomes impossible, not for want of means to carry the division to a greater extent, but because the particles into which the matter is divided are units in themselves, and by their nature cannot be divided; they are, in fact, atoms. Each of these atoms, it will be allowed, has a certain length, breadth, and thickness, and occupies a certain space. Since it occupies space, it must have different parts; for if we imagine the extremity of a plane of infinite tenuity to be placed so that it may be opposite to the centre of the atom and also touch it, there would clearly be a portion of the atom projecting on each side of the plane. If it did not do so, it would be a *point*, which has no magnitude, and therefore would no longer be an atom. It is evident from this, that an atom has different parts; and one would imagine that

these parts must be kept together by some law. According to the theory, the parts of the atom keep together because they are *one*, or, in other words, because they do. This is at best an unphilosophical method of explaining the constitution of an atom. Perhaps according to the theory, an atom has no constitution at all. In that case, it is difficult to imagine it to have any existence at all. If it is admitted that the different parts of the atom are held together by some law, it then ceases to be an atom. We have only to overcome this law, and the atom will separate.

Again; according to the theory, all forces such as attraction, &c. and motion, must exist *exterior* to the atom, and have nothing to do with its internal constitution; for it is inconsistent with the theory to imagine it to have any internal constitution. This being the case, what end is answered by the atom being there at all, for the material universe might go on just as well without it as with it. In short, why not adopt Faraday's theory of the existence of matter, or Berkeley's, of the non-existence of matter; for this last theory simply goes a step farther than Faraday's. The atomic theory viewed as a stepping-stone to these would seem to be philosophical. Taken alone it is difficult to understand in what respect it renders the explanation of chemical combination, &c. more simple than before. It appears to me rather to *hide* the difficulty than to explain it, for in what respect is it better to say one *atom* of H combines with one *atom* of O, and they together make one atom of HO; or to say one *equivalent* of H combines with one *equivalent* of O and they together make one *equivalent* of HO? When we express this reaction according to the atomic theory, we have done nothing more than remove the difficulty to the individual atoms, which can scarcely be considered as explaining the phenomenon.

In conclusion, I would make one observation with respect to what I have now written on this subject. In arguing this question with a scientific friend, we could not come to any conclusion, for this simple reason: he assumed the very point that I was endeavouring to raise a question upon, namely, the existence of an atom.—I am, &c.

GIMEL.

Chemical Notices from foreign sources, by Dr. T. L. PHIPSON.

I. MINERAL CHEMISTRY.

Nickel.—M. Charles Tissier has communicated to the Paris Academy of Sciences[1] a note upon some peculiar properties of nickel. This metal, which is placed near to iron in the electro-chemical tables of Berzelius, as also in the classification of metals in families by Ampère, is again brought near to the latter metal in M. Thénard's classification according to the affinity of metals for oxygen. However, although nickel resembles iron so closely by its atomic weight and by analogous compounds such as its salts, such is not the case when we consider nickel in other respects; thus it is generally supposed, on account of its place in the electro-chemical series, that nickel will precipitate copper from its solution as zinc and iron do. M. Tissier assures us, however, that no such phenomenon takes place. He has left pure fused nickel for 15 hours in a liquid containing a mixture of chloride of ammonium and sulphate of copper (1 part) and water (10 parts). At the end of this time no copper had been precipitated, and the piece of nickel which weighed 18·925 grammes before the experiment weighed exactly the same when it was terminated. A piece of bronze of aluminium placed in the same conditions has been found to lose 6 per cent. of its weight, and a piece of German silver more than 7 per cent.

All acids, save nitric acid, have only a weak solvent power on melted nickel. In 15 hours sulphuric acid diluted with twice its weight of water, only dissolved 0·032 grammes of 18 grammes submitted to its action. Strong hydrochloric acid only dissolved 0·15 grammes of the same quantity in the same time.

When these results are compared to those obtained with iron, zinc, copper, lead, and tin, it is seen how superior nickel is to these metals, and how much nearer it comes to silver; for like the latter it appears to be attacked with ease by nitric acid alone. According to M. Wertheim the tenacity of nickel is to that of iron as 90 is to 70. M. Tissier next informs us that nickel can be obtained in France, in the pure state, at 10 francs a pound (Eng.), or 20 francs the kilogramme, and that, at this price, with the properties it possesses, it is capable of many useful applications, among others that of serving in calico printing to take off the excess of colour or mordant from the cylinders. The bars at present used for this are of steel, which is soon attacked and destroyed by the sulphate of copper and other mineral substances employed as mordants or colours.

Bromide of Chromium.—MM. Wöhler and Bauck[2] have obtained bromide of chromium by passing a current of dry bromine into a red-hot tube containing small balls made of a mixture of charcoal, oxide of chromium, and starch—these balls were previously calcined.

Part of the bromide produced is volatilised beyond the mixture, and part remains in the latter forming crystalline laminæ. Bromide of chromium presents itself in hexagonal laminæ of a black colour, and with a semi-metallic lustre; seen by transparency these crystals appear of an olive green, and viewed in a certain direction they show also a feeble red tint. The powder they give is yellowish green. When heated in the air this bromide is transformed into green oxide. It is insoluble in water. The alkalies attack it easily. Hydrogen reduces it to a white bromide, even at a low temperature. M. Bauck has remarked that the violet-coloured sesquichloride of chromium becomes deliquescent when put in contact with tin, and soon gives a green liquid. The sesquibromide presents a similar property, the phenomenon being owing doubtless to a partial reduction of the salt, the protobromide formed in this circumstance causing the solution of the sesquibromide in the humidity of the atmosphere.

The analysis of the new substance which forms the subject of this paper has led M. Bauck to the formula Cr_2Br_3.

II. ORGANIC CHEMISTRY.

Urea in Chyle and in Lymph.—Guided by the idea that urea must be formed, not, as is sometimes thought, in the capillary bloodvessels, but in the interior of the tissues themselves, wherever the materials of the organism have become useless to life and are about to be eliminated by respiratory combustion, M. Wurtz[3] determined to seek for this substance in the chyle and in the lymph. The author in the first place examined the chyle of a bull upon which a fistula had been operated in the thoracic duct. He coagulated about 600 grammes of this liquid by means of heat; the filtered liquid was evaporated, the residue treated with absolute alcohol, and the alcoholic solution filtered and evaporated. The alcoholic extract thus obtained was treated with ether as long as anything dissolved; the ethereal solution left to itself soon furnished perfectly colourless crystals of urea. M. Wurtz afterwards found urea in the lymph of the dog, the cow, the bull, and the horse. In these cases he determined also the relative proportions of urea contained in the blood, the chyle and the lymph of the same animal by a combination of the methods proposed for determining urea by Liebig and Bunsen. The results obtained have been tabulated. The tables show that urea exists in the three liquids of a cow nourished on dry lucerne; 1000 grammes of the blood and 1000 grammes of the chyle containing 0·192 grammes of urea, the same quantity of lymph giving 0·193 grammes of urea.

On the Chemical Constitution of Cartilage.—Two distinct cartilaginous tissues are recognised in the animal world. The first constitutes the cartilage which forms the basis of the bones, *i. e.* which on being incrusted with

[1] *Comptes-Rendus*, 9 Jan. 1860.

[2] *Ann. der Chem. und Pharm.* t. cxi. p. 382.

[3] *Journ. de Pharm. et de Chimie*, Août 1859.

carbonate and phosphate of lime, forms the bony structures of the animal organism; this species is sometimes known as *collagenous*. The second, known as *hyalin cartilage* or *chondrogenous cartilage* is never transformed into bone. Up to the present time chondrogenous cartilage and collagenous cartilage have been looked upon as two distinct chemical varieties of the cartilaginous tissue. The collagenous cartilage obtained by the action of hydrochloric acid upon bones appear, in fact, to differ essentially from chondrogenous cartilage, which constitutes the hyalin cartilaginous tissue, or that cartilaginous tissue which is not yet penetrated with calcareous matter. The latter gives all the reactions which characterise *chondrine*; it is precipitated from its solutions by acetic acid, by acetate of lead, by alum, and by chloride of iron, whilst the former is not precipitated by these chemical agents, but only by tannic acid and corrosive sublimate.

Dr. Friedleben [4] does not deny these facts, but asserts that they are not sufficient to permit us to separate the two tissues as distinct varieties. These chemical differences result, according to the author, from the mode of preparation of the substances, and not from a primordial difference in the cartilaginous tissues. In fact, the chondrogenous tissue submitted for some time to the action of hydrochloric acid no longer gives the reactions of *chondrine*, but those which characterise *gelatine*, the basis of the collagenous tissues, in the same manner as the collagenous cartilage extracted from bones by hydrochloric acid. From this ingenious discovery it results that all the cartilaginous tissues of the animal economy present an identical constitution in a chemical point of view. It is well to add that some time time ago M. Schultze showed that caustic potash possessed the property of transforming chondrogenous tissues (chondrine) into collagenous cartilage (gelatine).

III. CHEMICAL ANALYSIS.

New Reagent for Alkaloids.— M. Schulze [5] has observed that if perchloride of antimony be added drop by drop to a solution of phosphoric acid a liquid is obtained which produces with ammoniacal salts, and with most of the alkaloids, precipitates similar to those which are formed by the phospho-molybdic acid of Sonnenschein; the following are the effects observed: —

Strychnine. — Solution of the nitrate at $\frac{1}{1000}$th abundant yellow caseous precipitate; at $\frac{1}{5000}$th white flocculent precipitate; at $\frac{1}{25000}$th slight turbidity.

Brucine.— Solution of the hydrochlorate at $\frac{1}{1000}$th a rose-coloured precipitate, soluble whilst warm, reprecipitated by cooling, leaving the supernatant liquid of a carmine red; at $\frac{1}{10000}$th the sesquichloride is still troubled, and the liquid takes a rose tint.

Quinine.—At $\frac{1}{1000}$th flocculent precipitate of a clearer colour than that of strychnine; at $\frac{1}{5000}$th the liquid becomes opalescent.

Cinchonine. — At $\frac{1}{1000}$th blue flocculent precipitate; at $\frac{1}{3000}$th slight turbidity.

Veratrine. — At $\frac{1}{1000}$th dirty white flocculent precipitate; at $\frac{1}{5000}$th the liquid becomes opalescent.

Narcotine.—At $\frac{1}{1000}$th copious yellow flocculent precipitate; at $\frac{1}{4000}$th turbidity; at $\frac{1}{25000}$th a turbidity in the liquid is still perceived.

Morphine.—At $\frac{1}{1000}$th the liquid is too dilute to produce a precipitate.

Codeine.—At $\frac{1}{1000}$th the turbid liquid takes a dirty brown colour.'

Nicotine.—At $\frac{1}{250}$th slight turbidity in the liquid.

Conine.—At $\frac{1}{250}$th liquid becomes slightly opalescent.

Piperine.—Yellow coloration even in diluted liquids.

Atropine.—At $\frac{1}{1000}$th caseous white precipitate, soluble in the warm liquid, completely thrown down again by cooling; at $\frac{1}{5000}$th slight turbidity, which becomes more sensible by long boiling.

Digitaline.—At $\frac{1}{1000}$th slight turbidity, which at first disappears by boiling, and then gives place to a voluminous precipitate.

Aconitine.—At $\frac{1}{1000}$th copious white precipitate; at $\frac{1}{5000}$th turbidity; at $\frac{1}{25000}$th liquid becomes opalescent.

Caffeine.—At $\frac{1}{1000}$th no reaction.

Theobromine. — At $\frac{1}{1000}$ slight muddiness.

[4] *Archiv. des Sc. Physiques de Genève*, Déc. 1859.
[5] *Journ. de Pharmacologie de Bruxelles*, Déc. 1859.

SCIENTIFIC NOTES AND QUERIES.

Purification of Water by means of Metallic Oxides.—Sir,—Pray allow me a few words in reference to a letter in the Chemical News for Jan. 7 (p. 60), bearing the signature of *J. Horsley*, pointing out oxide of manganese as a deodorising and decolouring agent for water, and referring to a letter of mine in your previous number, in which I speak of my early use of oxide of iron for similar purposes.

When I discovered the purifying powers of oxide of iron several years ago, it would indeed have been great shortcoming on my part had I failed to examine how far other oxides possessed the same; knowing, as every chemist must, that no one body in nature possesses any signal property without it being shared by others. In a word, when any one body is noted as possessing a peculiar physical property, it may be predicated that others of its class possess the same, though in a decreasing ratio. Deeming it therefore more than probable that this power could hardly be confined to oxide of iron, my early experiments included an examination of every other oxide insoluble in water. These resulted in showing that a variety of such bodies were endowed with similar powers, though in less degree than oxide of iron. Accordingly, in the specification of one of my patents (that of 1857), where, after describing the purifying properties of oxide of iron, I also show that those of manganese, nickel, and cobalt, possess similar powers, though in a minor degree, at the same time, from its greater energy, its general freedom from impurity, and its cheapness, oxide of iron is preferably recommended in practice.

Your correspondent will therefore see that what he finds in 1860 was published by me in 1857. Nor was it difficult to foresee that the bare publication of such a fact with regard to the oxide of iron, would soon set a certain class of chemists to find some other oxide with similar properties, but without any acknowledgment as to the source from whence they were obviously indebted for the idea. Therefore it was that previous to my official publication, I felt it my duty to extend my experiments over the other oxides.

Though already published in my paper read at Aberdeen, an abstract of which you have, perhaps you will permit me to repeat here that the oxides of the whole list of magnetic metals, amounting to eleven, possess this purifying power in relative degree. And, what was less to be expected, the oxides of some of the dia-magnetic metals as well. Among the latter oxide of silver ranks high. Besides these, several gums, resins, and tars, exercise a similar power on oxygen.

As regards the action of these bodies in effecting the purification of water, they cause the oxygen present in it to combine with the colouring matter, and thus convert it into carbonic acid.

In deodorising water, the action is altogether different. The sulphur from which odour is chiefly derived is absorbed by the oxides, and when saturated may be distilled off by heat. If the deodorisation were effected by means of oxygen, it is clear sulphuric acid would be formed, which would necessarily combine with the iron to form a protosalt of that metal. Thus adding an impurity to the water, and consuming the purifying agent itself. The addition of chloride of lime, spoken of by your correspondent would entirely prevent the oxidising action necessary for decoloration, on the one hand, and add nothing to the sulphur absorbing power on the other.—*Thomas Spencer.*

Homœopathic Medicines: Sir,—Having recently been requested to analyse some homœopathic globules for arsenic, I took 4 bottles, amounting to 2400 globules when, on dissolving them in ½ oz. of water, not the slightest indication of arsenic was obtained by Reinsch's test. Now, supposing $\frac{1}{20}$th of a grain to have been diffused over the whole of these globules, then *each* would represent $\frac{1}{48000}$, which ought to have afforded strong indications of arsenic, the aggregate estimate of these globules at $\frac{1}{20}$ times each, only $\frac{1}{100}$th the amount capable of being detected (viz. a millionth) would be the astonishing sum of 2 billion, 304 million times, yet not a particle of arsenic was made to show itself. What strong faith people must have!—*J. Horsley.*

LABORATORY MEMORANDA.

On the Action of Hydrosulphuric Acid on Perchloride of Iron.—When hydrosulphuric acid gas is passed into a solution of sesquichloride of iron, a dark purple colour is produced by every bubble of the gas, rapidly disappearing, and followed by the deposition of sulphur. This reaction is more distinctly perceived when water saturated with hydrosulphuric acid is added to the sesquichloride of iron; a beautiful rich purple liquid is then produced, which is perfectly clear at first, but very speedily deposits sulphur, its purple colour rapidly fading, and forms the well known milky liquid. The colour is a little more permanent when the sesquichloride of iron is dropped into the solution of hydrosulphuric acid.

The presence of hydrochloric acid, even in large quantity, does not prevent the production of the purple colour, though a larger quantity of solution of hydrosulphuric acid must be added.

The reaction is obtained even with a dilute solution of the iron salt, but not with very dilute hydrosulphuric acid.

Some specimens of solution of hydrosulphuric acid did not exhibit this behaviour.

Water which had been boiled for half an hour was allowed to cool in a rapid stream of hydrosulphuric acid; the solution thus obtained gave a very faint purple colour with the iron salt. After standing for some minutes in an open flask, it was capable of giving a far more intense colour.

A solution of hydrosulphuric acid which had been shaken with air in a test tube, or into which air had been blown through a glass tube, did not give the purple colour, though much sulphur was deposited, on adding sesquichloride of iron.

It is well known that the hyposulphites give a purple colour with sesquichloride of iron, but this colour is much redder and less rich than that under consideration; moreover, it does not fade quite so rapidly, and its disappearance is not attended with deposition of sulphur.—*C. L. B.*

MISCELLANEOUS.

Case of Poisoning by White Precipitate, at Petworth.—The name of the unfortunate person involved in this painful case is Harriet Moore, certainly not more than twenty years old. She was an inmate of the Petworth Union, and the question which the jury had to decide before the coroner (Mr. Richard Blagden) was, whether she had not destroyed her illegitimate child by the administration of white precipitate.

It appears that the deceased had been ill for some time past; that Mr. Short, the medical officer, was called to see it; that he administered for its malady, and it eventually recovered. On the Sunday, Monday, and Tuesday before its death, which took place on the Thursday, it seemed quite well again. On the Thursday evening, however, a person named Reimnan, who had been seen by the accused, was observed to give her a small parcel, which she put behind her back, and this was proved to be white precipitate.

Dr. Taylor said he would first proceed with the examination of the jars. He found the viscera in a good state of preservation. The lining membrane was congested at the upper part, and covered with mucus and extra food. There was no inflammation or ulceration about these parts, and the windpipe was in a healthy condition. The stomach had been opened and retied. He again opened it, and found a thick curdy whitish brown substance of the consistency of stiff paste; there was about enough to fill a large table spoon, and upon this was a thin and dark coagulation of blood. He found pasty matter closely adhering to the coats of the stomach, and mixed with mucus. On removing it, the greater part of the lining membrane of the stomach appeared pale, and towards the spinal opening there was a small patch arising from congestion of the lungs. The duodenum was greatly inflamed, and he observed a bright red colour. Inflammation was in the mucous and lining membranes chiefly. The liver, kidneys, heart, and lungs presented no appearance of disease. There was nothing about any of these organs to account for death. He then examined the different parts chemically, beginning at the upper and going down to the lower end. He took the gullet, and found it to contain a small quantity of a mercurial compound, and with it some starchy matter, which might be bread or arrowroot. On examining the contents of the stomach he found a number of chalky particles, which readily subsided when mixed with water. They did not dissolve, and had the appearance of mineral matter. He examined these contents microscopically and chemically, and found the greater part consisted of starchy matter (like gruel), undigested food, and mucus. With these was an insoluble compound of mercury, which had all the powers of white precipitate. He next examined the coats of the stomach after scraping away all the contents, and he found a small quantity of mercury in them. In the phial he did not discover any of the white particles which he had found in the stomach. He then proceeded to examine the napkins which had been forwarded in the brown paper parcel. He cut away a small portion of one of them with the matter upon it, which was of a green colour. It was found to contain, among other things, mucus, bile, and starchy matter, and a comparatively large quantity of a mercurial compound—that was, more than he had found in the body. In another portion of the napkin, which was unstained, he found starchy matter, but no mercury. He examined one half of the heart; no mercury was present. He examined a fifth part of the liver, and found mercury in it; and he afterwards examined one of the kidneys and separated mercury from it. From his examination and analysis he had drawn up certain conclusions which might be embodied thus:—First, that a mercurial compound, which he believed to be white precipitate mixed with farinaceous and other matter, was found in the contents of the stomach of the deceased infant; secondly, that a mercurial compound also mixed with starchy matter and mucus, was found in the discharge in the napkin; thirdly, that a mercurial compound and starchy matter were found in the middle portion of the gullet, and in the lower portion of the small intestines, and that mercury without starch was found in the various parts of the small and large intestines, as well as in the liver and one of the kidneys; fourthly, that the appearances presented by the viscera were redness in the gullet, a patch of redness in the stomach, and great redness with injections in the upper part of the small intestines—less in the large intestines (the redness of an inflammatory nature being what was called acute inflammation)—it was seated in the mucous or lining membrane, and such as might have been produced either by the action of an irritant substance, or else by the result of disease, and, fifthly and lastly, the heart, lungs, liver, kidneys, and spleen presented no appearance of disease and no appearance to account for death.

Dr. Taylor was then cross-examined at great length by the Coroner and jury, and simplified his evidence by further explanation, from which it appeared that this was a most extraordinary case, from the fact of white precipitate having been so rarely administered internally. He knew of only one case, and that was at Chelmsford Assizes, twelve years ago, in which he was engaged. The patient had taken twenty-five grains, and recovered. The whole point was this—whether the system possessed sufficient strength to throw it off by vomiting.

The jury, after consulting for about an hour, returned a unanimous verdict of wilful murder.

ANSWERS TO CORRESPONDENTS.

C. P.—The processes are necessarily complicated. The best account we know is in the *Handbook of Chemistry*, by Abel and Bloxam.

S. J. had better advertise in the Chemical News. There are several gentlemen who give instruction.

W. G. (Oxford).—You are quite right in the first case. In the second the chloroform separates, and the mixture must be well shaken before a dose is measured.

F. W.—1, Gum-Arabic is insoluble in alcohol. 2, We cannot say.

R. J. S.—Equal weights of sal ammoniac, nitrate of potash, and common salt, and cold water equal to the weight of the mixed salts, form the best freezing mixture that we are acquainted with.

N. F.—We know of none available for our correspondent's purpose.

Amateur (Glasgow).—All the receipts are bad. The ink will inevitably destroy the paper. As space permits, we shall give the information desired.

A Reader.—The articles are not quoted in price currents. Ure's Dictionary will give the information.

A. B. (Bradford).—Uric acid can be obtained from urine: but the quantity is very small, and is very difficult to purify.

W. G. (Leeds).—Dr. Odling has a work in the press, nearly ready, which will fully explain the Unitary system of Chemical Notation.

Chemist.—The true Brunswick green is subchloride of copper.

A Sub. (Manchester).—We believe not.

Books and Journals received.—The Dublin Medical Press. The Practice of Hiring Wet Nurses, &c.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On some Properties of the Platinum Metals, by MM. DEVILLE *and* DEBRAY.[1]

THE platinum metals have particular characters, which completely separate them from the more or less natural divisions, into which the other metals have been formed. It will be well, in our opinion, to make of them a single group, which shall contain them all and admit no others. It is true that these metals are not analogous in every respect; but they have a common physiognomy, and a peculiar character which will always oblige us to study them together, even if, with a view to a rational classification, they should be distributed among different families of the simple bodies.

These metals are never found apart from one another, except, and then but rarely, palladium; and palladium is, of all of them, the one most nearly allied to the other metals. More or less alterable under the influence of oxygen and chlorine, they are all allied by the facility with which they give up to reducing agents the elements with which they are combined. Their principal affinities are for the halogen bodies, such as chlorine, bromine, iodine and cyanogen; and with these bodies they all give birth to compounds characteristic of the series of platinum metals. Besides this they all have the curious property of determining a number of chemical reactions by their simple contact — their *catalytic action* as it has been called by Berzelius. This last action cannot be ascribed to the porosity of the metals, for platinum which has been melted and worked with the hammer is as active in this respect as platinum which has been obtained by the aggregation of its powder.

The differences between these bodies are equally remarkable. Thus osmium which burns in the air and gives rise to vapours of osmic acid, has been compared by Berzelius to arsenic; later, M. Dumas inclines to range it by the side of tellurium: but most assuredly it is a metalloid, the metalloid of the platinum series. Ruthenium is allied to tin by its chemical properties and the form of its oxide. Palladium resembles silver in its volatility, its oxidability, and its action upon hydriodic acid, &c.; but the strong basic property of oxide of silver is not met with in any of the oxides of palladium. Rhodium cannot be compared with any other metal. It resembles silver in its oxidability by heat, in the basic properties of its principal oxide, and in the remarkable action which it exerts upon sulphuric acid or rather the bisulphate of potash; and is like gold in the reactions of its chlorides. Platinum is in all its properties a true analogue of gold. Iridium presents few analogies with the ordinary metals, being superior to all of them in its resistance to the action of our most powerful reagents; and if its physical properties were in accordance with its chemical, iridium rather than gold would be the king of metals.

[1] Abridged from the *Annales de Chimie et de Physique*.

We now proceed to give in detail the author's account of the metals.

1. **Osmium.** — Until now osmium has been prepared in such a state that the history of its physical properties is as incomplete as that of iron would be if we only knew it in the pyrophoric condition, or as silicium or boron, if they were only known as amorphous matters eminently combustible. We have considered osmium as a metalloid; and in fact, like a certain number of metalloids, osmium has the power of entirely changing its chemical and physical properties according to the manner in which it is prepared. Ordinary osmium, prepared according to the process of Berzelius, is a spongy, half metallic mass, which gives off an odour of osmic acid, indicating a sensible alteration by oxygen at the ordinary temperature. It density is equal to 7. If however it is obtained by reducing the vapour of osmic acid with hydrogen, it is metallic and has a density of about 10.

Pulverulent Osmium. — But osmium appears with altogether different characters when prepared in the following manner. We take osmide of iridium in fine powder — if we have none naturally pulverulent we reduce the scales to powder chemically, by calcining them with 4 or 5 times their weight of zinc. When all trace of the zinc has disappeared from the flame we allow the crucible to cool, and there is found a porous friable mass weighing exactly as much as the osmide introduced. One part of this is mixed with 5½ times its weight of binoxide of barium, and the mixture is heated for an hour or two in a well covered crucible to the temperature of melted silver. After this a black homogeneous mass is found which we break up and place in a glass retort; a little water is then added and afterwards 8 parts of hydrochloric and 1 part of nitric acid. These are shaken together and distilled, taking care to keep the receiver well cooled to avoid the escape of the osmic vapours. When the vapour no longer has the smell of osmic acid, the distillation is stopped, and the liquid in the receiver is distilled afresh, and the product is condensed in diluted ammonia.

The osmiate of ammonia is supersaturated with sulphuretted hydrogen, and the liquor containing the sulphide of osmium is boiled for some time and then filtered.

The sulphide of osmium, dried at a low heat, is placed in a crucible of coke, which is itself enclosed in another crucible of refractory clay and then heated for 4 or 5 hours to the temperature of melted nickel. The sulphide is reduced by the heat and there is left a brilliant metal of a blue colour brighter than that of zinc. If the heat is raised to that of melted rhodium we have a metal whose density is equal to 21·3 or 21·4. This osmium is without smell and only becomes combustible at a temperature higher than that of melted zinc.

Crystallised Osmium. — When osmium is heated to bright redness with 7 or 8 times its weight of tin in a charcoal crucible, and the melted mass is allowed to cool slowly, the osmium separates in a crystalline form. It is

only necessary to dissolve out the tin with hydrochloric acid, to obtain the crystals of osmium in a state of purity. The crystals are too small to be measured: they are probably rhomboidal dodecahedra with cubic faces.

Compact Osmium.—When osmium is dissolved in zinc, and the zinc afterwards separated by hydrochloric acid, osmium is obtained as a very combustible amorphous powder; but when the zinc is volatilised, and the residue is submitted to the heat of the gas furnace (the apparatus was described in No. 1 of the CHEMICAL NEWS) the osmium is found completely metallic with the brightness and blue colour characteristic of the metal: it is not melted but is full of irregular cavities. This osmium scratches glass easily. We have tried in vain to fuse it at a temperature which we estimate to correspond with that of melted rhodium.

After this treatment osmium has a metallic lustre and a light blue colour. Its density=21·4. It presents no appearance of a fusion; and as no smell of osmium was perceived during the operation, we may say that in closed vessels, at the temperature at which rhodium fuses, osmium is infusible and fixed. It is not so at the heat of melted iridium, for when this temperature is attained considerable quantities of osmium disappear, and are deposited on any cold body interposed near the flame. We conclude from these experiments that at the temperature at which iridium is in complete fusion, and platinum itself is vaporised, osmium becomes volatile, but even the practised eye which follows the operation can discover no trace of fusion.

MM. Thenard and Dulong discovered that osmium like platinum has the power of effecting the combination of bodies by simple contact with the reacting substances. Our experiments have confirmed this not only with regard to osmium but with all the metals of the platinum series, in which it exists to a remarkable degree.

Osmic Acid.—Osmic acid is prepared dry by roasting according to the process of M. Fremy, which sometimes succeeds well and sometimes badly according to the nature of the osmides. When they are not easily roasted we mix them with 8 or 10 times the weight of zinc and digest at a red heat for some hours, and then treat the alloy with hydrochloric acid, which leaves a powder so combustible that osmic acid is disengaged at the ordinary temperature, and which takes fire at 400° C.

As osmic acid boils at about 100° C. it is easy to take the density of the vapour. The first determination at the temperature of 246° C. gave 8·99; the second at 286° C. gave 8·88. The density is calculated at 9.

Ruthenium.—After osmium, ruthenium is the most refractory metal we are acquainted with. It requires a very extreme heat to melt the smallest quantity. When melting there is formed the oxide of ruthenium (RuO_2) which is volatilised, and which smells something like osmic acid. When removed from the flame ruthenium is blackish-brown on the surface and is brittle and hard like iridium. It is only distinctly separated from this last metal by its density, which is obviously half that of iridium. The purest ruthenium we could obtain weighed from 11 to 11·4; it had been fused a great number of times in nitre and potasse, in which iridium becomes insoluble when the ruthenium is in great excess.

To prepare the metal we mix the osmide in fine powder with 3 parts of binoxide of barium and 1 part of nitrate of baryta and heat them to redness in a clay crucible for an hour. The black friable mass which remains is powdered with great care and introduced into a flask in which has been previously mixed 20 parts of water and 10 parts of ordinary muriatic acid. The flask must be placed in cold water to avoid the elevation of temperature which would ensue from the violent reaction which takes place. This operation should be conducted under a good chimney to avoid the escape of the osmic acid vapour into the laboratory.

When this reaction is finished 1 part nitric acid is added, and then 2 parts ordinary strong sulphuric acid. The flask is now well shaken, and the sulphate of baryta is allowed to deposit. The supernatant liquid is then poured off, the precipitate is washed by decantation, and the liquid and the washings are distilled together in a tubulated retort, until about a fourth of their volume of a liquid very rich in osmic acid has passed over. The red liquor which is left in the retort is evaporated to a small volume, 2 or 3 parts of sal ammoniac in small pieces are added, and a small quantity of nitric acid. The whole is now evaporated to dryness at the temperature of boiling water. A crystalline violet-black precipitate remains in the capsule, which we treat with a small quantity of water partly saturated with sal ammoniac, and wash with the same solution until it is no longer coloured. The insoluble salt left (chloro-iridiate of ammonia containing ruthenium) is heated by degrees to redness in a porcelain crucible. The mixture of iridium and ruthenium thus obtained is fused in a silver crucible with an equal weight of hydrated potash and twice its weight of nitre, and when cold the ruthenate of potash is dissolved out with cold water: the solution, which is yellow, is decomposed by means of carbonic or nitric acid, and the precipitated oxide of ruthenium is strongly calcined in a charcoal crucible. The ruthenium is then reduced in the apparatus before described. Iridium and ruthenium present many analogies; their coloured reactions are the same, and the oxide of iridium dissolves in a mixture of nitre and potash.

Ruthenium forms with zinc an alloy which will burn in the air; it crystallises in hexagonal prisms. With tin there is formed an alloy $RuSn_2$, which crystallises in cubes as beautiful in their form and lustre as crystallised bismuth.

Palladium.—This is the most fusible of all the platinum metals. The gas furnaces (page 6, CHEMICAL NEWS) easily bring it into a liquid state, and when heated to the temperature of fused iridium it disappears, giving off green vapours, which condense into a bistre-coloured dust, being a mixture of the metal and its oxide. Heated in contact with the air, and maintained in a state of fusion in an oxidising atmosphere, it *spits* like silver at the moment of solidification; but the exterior of the button is smooth, while the interior is cavernous. It is more oxidisable than silver, for it tarnishes in the air. The density of pure palladium, melted but not hammered, is 11·4 at the temperature 72° Fahr.

Palladium is soluble in zinc, but does not combine with it. By fusion with tin, however, it forms an alloy which crystallises in brilliant laminæ, having the composition Pd_2Sn_3. Silver and copper, which have a great analogy to palladium, give alloys with tin, exactly resembling the foregoing in form and composition.

Rhodium.—Rhodium is obtained by fusing platinum residues with an equal weight of lead and twice its weight of litharge. When the crucible has attained a bright red heat, and the litharge is thoroughly liquid, the crucible is shaken once or twice, and is then allowed to cool slowly. The button of lead, which contains all the metals in the residue less oxidisable than lead, is treated with nitric acid diluted with an equal volume of water, which removes besides the lead the copper and

the palladium. The insoluble powder which remains is mixed with five times its weight of binoxide of barium, weighed exactly, and is heated to redness in a clay crucible for one or two hours. After this it is first treated with water, and then with aqua regia to remove the osmic acid. When the liquor has lost all smell, sufficient sulphuric acid is added to exactly precipitate the baryta. It is then boiled, filtered, and evaporated, first adding to it a little nitric acid and then a great excess of sal ammoniac. The evaporation is carried to dryness at 212°, and the residuum is washed with a concentrated solution of sal ammoniac which removes all the rhodium. When the washings are no longer coloured, the liquor is evaporated with a great excess of nitric acid, which destroys the sal ammoniac, and when only the salt of rhodium is left, the evaporation is finished in a porcelain crucible. The rhodium salt is now moistened with hydrosulphuret of ammonia, mixed with three or four times its weight of sulphur, and the crucible is heated to bright redness, after which metallic rhodium is left in the crucible. So obtained rhodium may be considered almost pure, after it has been boiled for some time first in aqua regia, and then in concentrated sulphuric acid. To obtain it perfectly pure it must be melted with four times its weight of zinc. The alloy is treated with concentrated hydrochloric acid which dissolves most of the zinc but leaves a crystalline matter which is really an alloy of rhodium and zinc in definite proportions. This is dissolved in aqua regia, and the solution is treated with ammonia until the precipitate first formed is redissolved. The solution is boiled and evaporated, by which is obtained the yellow salt, or chloride of rhodium. This is purified by repeated crystallisation, and then calcined with a little sulphur, by which means rhodium is procured absolutely pure.

Rhodium melts less easily than platinum, so much so that the same fire which will liquefy 300 grammes of platinum will only melt 40 or 50 grammes of rhodium. It is not volatilised, but it oxidises on the surface like palladium. Less white and lustrous than silver it has about the same appearance as aluminium. When perfectly pure it is ductile and malleable, at least after fusion. Its density is 12·1.

The alloys of rhodium, those at least which have been examined, are true chemical combinations, as is shown by the high temperature developed at the moment of their formation. The alloy with zinc already described resists the action of muriatic acid, but in contact with *air* and the *acid* there is soon a well marked rose coloration which reveals an oxidation of the two metals under the double influence of the air and acid. The alloy with tin is crystallised, black, brilliant and fusible at a very high temperature.

Iridium.—The chloro-iridiate of ammonia containing ruthenium obtained in the preparation of the latter metal is dried and calcined, whereby a powder is obtained from which we remove the last traces of chlorine and oxygen by means of a current of hydrogen. Platinum and a little of the osmium are extracted by aqua regia and the ruthenium is separated by fusion with nitre and potassa, followed by prolonged washing with water. The osmium which remains is removed by placing the metal in the oxidising flame of the blowpipe; and the metal is then melted in the lime furnace, using, however, pure hydrogen in the place of coal gas. The colour of iridium is pure white, somewhat resembling polished steel. It breaks under the hammer at the ordinary temperature of the air; but it becomes malleable when it is raised to a bright white heat.

PHARMACY, TOXICOLOGY, &c.

On some Specimens of Dugong Oil, by W. T. Fewtrell.

A few years ago Dr. Hobbs, the health officer at Moreton Bay introduced the oil obtained from the dugong as a substitute for cod-liver oil. This animal is one of the herbivorous cetacea, and is found on the northern coast of Australia, in the Red Sea, the Persian Gulf, and also in the Indian seas. *Dugong*, *dou-joung*, or *duyong*, is a Malay word, which signifies sea-cow. The Dutch in the Indian archipelago called it *zee-koe;* among the Spaniards it was known as the *peixe dono*, or sea-woman; and French naturalists have given it the name of *halicore*, sea-girl or syren. The Red Sea variety has been named by Ruppel the *Halicore tabernaculus*, in consequence of historical researches having led him to the conclusion that it was with the skin of this animal that the Jews were ordered to veil the tabernacle. In the Indian seas it is sometimes found of large size, from 18 to 20 feet long; but in Australia it is seldom found longer than 12 or 14 feet. The following description of the animal is borrowed from the *Naturalists' Library* and other works. In its general form the dugong resembles the common whale. The skin is smooth and thick, bluish above and white beneath, with a few remote and scattered hairs; the mammæ are situated on the chest, under the fins. The head is small in proportion and of a peculiar form. The upper lip is very large, thick, and obliquely truncated, forming a short, thick, and nearly vertical kind of snout, something like the trunk of an elephant cut short across. The surface of the truncated portion is covered with soft papillæ, and furnished with a few bristles; the lips are covered with a horny substance which assists in tearing the sea-weeds for food. The lower lip is much smaller, and resembles a round or oblong chin. To assist the animals in browsing upon the submarine vegetables, the anterior portion of the jaw is bent downwards at an angle, in such a way as to bring the mouth into a nearly vertical position. The greatest peculiarity of the animal is that the ventricles of the heart are widely detached from each other, being connected at the base only. Another singular circumstance is that the *inside* of the cheeks are studded with strong projecting bristles. The pectoral fins resembling swimming paws, have no nails, but are verrucose. The tail is broad, horizontal, and crescent-shaped.

"Its favourite haunts are the mouths of rivers and straits between proximate islands, where the depth of water is but trifling (three or four fathoms), and where, at the bottom, grows a luxuriant pasturage of submarine algæ and fuci. Here, in calm weather, may small troops be seen feeding below the surface, and every now and then rising to take breath. The position of the mouth, the muscular powers, and mobility of the lips, garnished with wiry bristles, and the short incisor tusks of the upper jaw, enable these animals to seize and drag up the long fronds of sub-aquatic vegetables, which constitute their nourishment. The mutual affection of the male and female is very great, and the latter is devoted to her offspring. If a dugong be killed, the survivor of the pair, careless of danger, follows after the boat carrying the body, impelled by an overmastering passion, and thus often shares the fate of its partner; indeed if one be taken, the other is an easy prize."

It is taken by Malays and also by the aborigines of Moreton Bay for the sake of its flesh, which is said to be very delicate and palatable, and to resemble young beef. The natives of Australia also used the oil for

burning. Mr. Archer, who was at Moreton Bay before the oil was used as a medicine, tells me that the natives waited until a shoal got into a shallow water, and then surrounded and drove them into large nets. The oil was obtained by skinning the fish and then boiling down the "speck." Not much was obtained, the annual produce being estimated at about 200 gallons. Mr. Archer adds that when opened the stomach of the animal was always found full of sea-weeds and *live worms*.

Now that a large demand for the oil has sprung up, a fishery has been organised, and the dugong has been taken in great numbers, but still not sufficient to supply the amount of oil in requisition; and the deficiency would appear to be made up from an altogether different source.

But small quantities of what is called dugong oil have arrived in England, and I have only had the opportunity of examining three specimens. One was kindly given to me by Dr. Letheby, who received it some years ago before the oil was in repute. Another, also given to me by Dr. Letheby, was, I believe, received at the Consumption Hospital a few months ago. The third was imported expressly for me by Messrs. Johnson and Archer, Australian merchants. The price paid in Australia for a bottle containing about a pound and a quarter was 12*s.* 6*d.* All these specimens are solid at the ordinary temperature of the air, but with the first (which is of a brown colour) there is a small quantity of dark coloured oil on the surface. The others are white and perfectly solid. Considering the supposed source of the oil, it would be imagined that the dugong oil would present the same appearances, have the same smell and behave in the same way with chemical tests as the oils obtained from other cetaceans. Such, however, is not the case with the specimens I have examined, except, and then but partially, with the first. Of the smell of the first it is impossible to speak, for it has become so rancid that the natural smell of the fresh oil must be entirely gone. The other two when cold have a faint odour of tallow, which is greatly heightened when the oil is made hot. Strong sulphuric acid dropt on the first produces a deep brown colour—on the other two, only a pale yellow colour. Chlorine gas passed through the first deepened the original brown colour, but the other two were unaffected by it. Now, remembering the action of these reagents on the oil from other cetaceans, I am inclined to think that neither of these three samples is genuine. I speak with diffidence in the absence of a well authenticated specimen to use as a standard of comparison; but I believe that two out of the three are entirely factitious (mixtures probably of a vegetable oil with some solid animal fat), and that the other is largely adulterated. I am confirmed in this opinion by the following statement made by Dr. Hobbs in the *Melbourne Argus*:—"During a given period, when there was being sold in Sydney 50 gallons weekly, and in Melbourne 100 gallons weekly, there was little more than 100 gallons got from the Bay."

Under these circumstances, I would recommend an importer to receive with caution any consignment of the so-called dugong oil. It does not seem to possess any decided advantage over cod-liver oil, and its principal recommendation in Australia is that it is a colonial production. The very high price will prevent the export of much to England; and in a few years the supply will most likely cease. Several years ago a Frenchman wrote: "Tout annonce que dans quelques années le dugong aura entièrement disparu de dessus le globe;" and it is likely that the prophecy will be speedily accomplished as far as Australia is concerned.

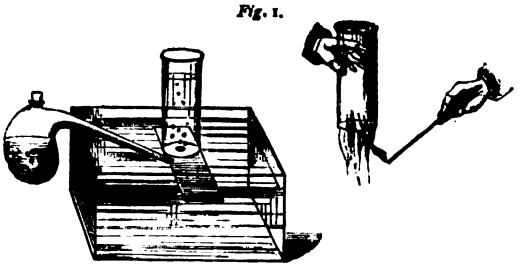
ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures[1] *(adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i. e. of such as are called the Physical or Inorganic Forces—including an Account of their Relations to each other; by* M. Faraday, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

Lecture IV. (Jan. 5, 1860.) *Chemical Affinity—Heat.*

We shall have to pay a little more attention to the forces existing in water before we can have a clear idea on the subject. Besides the attraction which there is between its particles to make it hold together as a liquid or a solid, there is also another force, different from the former;—one which by means of the voltaic battery we yesterday overcame, drawing from the water two different substances, which when heated by means of the electric spark attracted each other, and rushed into combination to reproduce water. Now the best thing I can do to day is to continue this subject, and trace the various phenomena of chemical affinity; and for this purpose, as we yesterday considered the character of oxygen, of which I have here two jars (oxygen being those particles derived from the water which enable other bodies to burn), we will now consider the other constituent of water, and without embarrassing you too much with the way in which these things are made, I will proceed now to show you our common way of making *hydrogen*. (I called it hydrogen yesterday—it is so called because it helps to generate water.)[2] I put into this retort some zinc, water, and oil of vitriol, and immediately an action takes place, which produces an abundant evolution of gas now coming over into this jar, and bubbling up in appearance exactly like the oxygen we obtained yesterday.

Fig. 1.



The processes you see are very different, though the result is the same in so far as it gives us certain gaseous particles. Here then is the hydrogen; I showed you yesterday certain qualities of this gas, now let me show you some other qualities. It is a combustible substance, not like the oxygen, which is a supporter of combustion, although it will not burn. There is a jar full of it, and if I carry it along in this manner, and put a light to it, I think you will see it take fire, not with a bright light,—you will at all events hear it if you do not see it. Now that is a body entirely different from oxygen; it is extremely light; for although you yesterday saw twice as much of this hydrogen produced on the one side as the other, by the voltaic battery, it was only one eighth the weight of the oxygen. I carry this jar upside down. Why? Because I know that it is a very light body, and that it will continue in this jar upside down quite as effectually as the water will in that jar which is not upside down; and just as I can pour water from one vessel into another in the right position to receive it, so can I pour this gas from one jar into another when they are upside down. See what I am about to do,—there is no hydrogen in this jar at present, but I will gently turn this jar of hydrogen up under this other jar (*fig.* 2.) and then we will examine the two. We shall see, on applying a light, that the hydrogen has left the jar in which it was at first, and has poured upwards into the other, and there we shall find it.

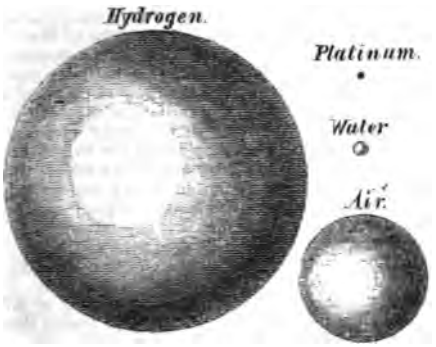
Fig. 2.

You now understand that we can have particles of very diffe-

[1] Reported verbatim by special permission.
[2] ὕδωρ, "water," and γείνομαι, "I generate."

rent kinds, and that they can have different bulks and weights; and there are two or three very interesting experiments which serve to illustrate this. For instance, if I blow soap bubbles with the breath from my mouth you will see them fall, because I fill them with common air, and the water which forms the bubble carries it down. But now if I inhale hydrogen gas into my lungs (it does no harm to the lungs, although it does no good to them), see what happens. [The Lecturer inhaled some hydrogen, and after one or two ineffectual attempts, succeeded in blowing a splendid bubble, which rose majestically and slowly to the ceiling of the theatre, where it burst.] That shows you very well how light a substance this is; for notwithstanding all the heavy bad air from my lungs, and the weight of the bubble, you saw how it was carried up. I want you now to consider this phenomenon of weight as indicating how exceedingly different particles are one from the other: and I will take as illustrations these very common things, air, water, the heaviest body—platinum—and this gas, and observe how they differ in this respect; for if I take a piece of platinum of that size (*fig.* 3.) it is equal to the weight of portions of water, air, and hydrogen of the bulks I have represented in

Fig. 3.



these spheres; and this illustration gives you a very good idea of the extraordinary difference with regard to the gravity of the articles having this enormous difference in bulk. [The following tabular statement having reference to this illustration appeared on the diagram board.]

Hydrogen	1		
Air	14·4	1	
Water	11943	829	1
Platinum	256774	17831	21·5

Whenever oxygen and hydrogen unite together they produce water, and you have seen the extraordinary difference between the bulk and appearance of the water so produced and the particles of which it consists chemically. Now we have never yet been able to reduce either oxygen or hydrogen to the liquid state; and yet their first impulse when chemically combined is to take up first this liquid condition and then the solid condition. We never combine these different particles together without producing water; and it is curious to think how often you must have made the experiment of combining oxygen and hydrogen to form water without knowing it. Take a candle, for instance, and a clean silver spoon (or a piece of clean tin will do), and if you hold it over the flame you immediately cover it with a dew—not a smoke—which presently evaporates. This perhaps will serve to show it better. Mr. Anderson will put a candle under that jar, and you will see how soon the water is produced (*fig.* 4.). Look at that dimness on the sides of the glass, which will soon produce drops and trickle down into the plate Well, that dimness and these drops are *water*, formed by the union of the oxygen of the air with the hydrogen existing in the wax of which that candle is formed.

Fig. 4.

And now, having brought you in the first place to the consideration of chemical attraction, I must enlarge your ideas so as to include all substances which have this attraction for each other—for it changes the character of bodies, and alters them in this way and that way, in the most extraordinary manner; and produces other phenomena wonderful to think about. Here is some chlorate of potash, and there is some sulphuret of antimony. We will mix these two different sets of particles together, and I want to show you in a general sort of way, some of the phenomena which take place when we make different particles act together. Now I can make these bodies act upon each other in several ways. In this case I am going to apply heat to the mixture, but if I were to give it a blow with a hammer the same result would follow. [A lighted match was brought to the mixture, which immediately exploded with a sudden flash, evolving a dense white smoke.] There you see the result of the action of chemical affinity, overcoming the attraction of cohesion of the particles. Again, here is a little sugar, quite a different substance from the black sulphuret of antimony, and you shall see what takes place when we put the two together. [The mixture was touched with sulphuric acid, when it took fire and burnt gradually and with a brighter flame than in the former instance.] Observe this chemical affinity! travelling about the mass, and setting it on fire, and throwing it into such wonderful agitation.

I must now come to a few circumstances which require careful consideration. We have already examined one of the effects of this chemical affinity—but to make the matter more clear we must point out some others. And here are two salts dissolved in water. They are both colourless solutions, and in these glasses you cannot see any difference between them. But if I mix them, I shall have chemical attraction take place. I will pour the two together into this glass, and you will at once see, I have no doubt, a certain amount of change. Look, they are already becoming milky, but they are sluggish in their action—not quick as the others were—for we have endless varieties of rapidity in chemical action. Now if I mix them together, and stir them so as to bring them properly together, you will soon see what a different result is produced. As I mix them they get thicker and thicker, and you see the liquid is hardening and stiffening, and before long I shall have it quite hard; and before the end of the lecture, it will be a solid stone—a wet stone no doubt, but more or less solid—in consequence of the chemical affinity. Is not this changing two liquids into a solid body a wonderful manifestation of chemical affinity?

There is another remarkable circumstance in chemical affinity, which is that it is capable of either waiting or acting at once. And this is very singular, because we know of nothing of the kind in the forces either of gravitation or cohesion. For instance, here are some oxygen particles, and here is a lump of carbon particles. I am going to put the carbon particles into the oxygen; they *can* act, but they *do* not—they are just like this unlighted candle. It stands here quietly on the table, waiting until we want to light it. But it is not so in this other case: here is a substance, gaseous like the oxygen, and if I put these particles of metal into it the two combine at once. The copper and the chlorine unite by their power of chemical affinity, and produce a body entirely unlike either of the substances used. And in this other case, it is not that there is any deficiency of affinity between the carbon and oxygen, for the moment I choose to put them in a condition to exert their affinity, you will see the difference. [The piece of charcoal was ignited, and introduced into the jar of oxygen, when the combustion proceeded with vivid scintillations.]

Now this chemical action is set going exactly as it would be if I had lighted the candle, or as it is when the servant puts coals on and lights the fire: the substances wait until we do something which is able to start the action. Can anything be more beautiful than this combustion of charcoal in oxygen? You must understand that each of these little sparks is a portion of the charcoal, or the bark of the charcoal, thrown off white-hot into the oxygen, and burning in it most brilliantly as you see. And now let me tell you another thing, or you will go away with a very imperfect notion of the powers and effects of this affinity. There you see some charcoal burning in oxygen. Well, a piece of lead will burn in oxygen just as well as the charcoal does, or indeed better, for absolutely that piece of lead will act at once upon the oxygen as the copper did in the other vessel with regard to the chlorine. And here also is a piece of iron; if I light it and put it into the oxygen, it will burn away just as the carbon did. And I will take some lead and show you that it will burn in the common atmospheric oxygen at the ordinary t[illegible] These are the lumps of lead which you remember

other day — the two pieces which clung together. Now these pieces, if I take them to day and press them together, will not stick, and the reason is that they have attracted from the atmosphere a part of the oxygen there present, and have become coated as with a varnish by the oxide of lead which is formed on the surface, by a real process of combustion or combination. There you see the iron burning very well in oxygen, and I will tell you the reason why those scissors and that lead do not take fire whilst they are lying on the table. Here the lead is in a lump, and the coating of oxide remains on its surface, whilst there you see the melted oxide is clearing itself off from the iron, and allowing more and more to go on burning. In this case, however [holding up a small glass tube containing lead pyrophorus], the lead has been very carefully produced in fine powder, and put into a glass tube and hermetically sealed so as to preserve it, and I expect you will see it take fire at once. This has been made about a month ago, and has thus had time enough to sink down to its normal temperature — what you see therefore is the result of chemical affinity alone. [The tube was broken at the end, and the lead poured out on to a piece of paper, whereupon it immediately took fire.] Look, look, at the lead burning; why it has set fire to the paper. Now that is nothing more than the common affinity always existing between very clean lead and the atmospheric oxygen; and the reason why this iron does not burn until it is made red-hot, is because it has got a coating of oxide about it which stops the action of the oxygen,—putting a varnish, as it were, upon its surface, as we varnish a picture—absolutely forming a substance which prevents the natural chemical affinity between the bodies from acting.

I must now take you a little further in this kind of illustration, or consideration I would rather call it, of chemical affinity. This attraction between different particles exists also most curiously in cases where they are previously combined with other substances. Here is a little chlorate of potash containing the oxygen which we found yesterday could be procured from it; it contains the oxygen there combined and held down by its chemical affinity with other things; but still it can combine with sugar, as you saw. This affinity can thus act *across* substances, and I want you to see how curiously what we call combustion acts with respect to this force of chemical affinity. Suppose I take a piece of phosphorus and set fire to it, and then place a jar of air over the phophorus, you see the combustion which we are having there on account of chemical affinity (combustion being in all cases the result of chemical affinity). The phosphorus is escaping in that vapour, which will condense into a snow-like mass at the close of the lecture. But suppose I limit the atmosphere, what then? why, even the phosphorus will go out. Here is a piece of camphor which will burn very well in the atmosphere, and even on water it will float about and burn, by reason of some of its particles gaining access to the air. But if I limit the quantity of air by placing a jar over it, as I am now doing, you will soon find the camphor will go out. Well, why does it go out? not for want of air, for there is plenty of air remaining in the jar. Perhaps you will be shrewd enough to say for want of oxygen.

This therefore leads us to the inquiry as to whether oxygen can do more than a certain amount of work. The oxygen there (*fig.* 4.) cannot go on burning an unlimited quantity of candle, for that has gone out, as you see; and its amount of chemical attraction or affinity is just as strikingly limited; it can no more be fallen short of or exceeded than can the attraction of gravitation. You might as soon attempt to destroy gravitation, or weight, or all things that exist, as to destroy the exact amount of force exerted by this oxygen. And when I pointed out to you that 8 by weight of oxygen to 1 by weight of hydrogen went to form water, I meant this, that neither of them would combine in different proportions with the other, for you cannot get 10 of hydrogen to combine with 6 of oxygen, or 10 of oxygen to combine with 6 of hydrogen — it must be 8 of oxygen and 1 of hydrogen. Now suppose I limit the action in this way; this piece of cotton-wool burns, as you see, very well in the atmosphere; and I have known of cases of cotton-mills being fired as if with gunpowder, through the very finely divided particles of cotton being diffused through the atmosphere in the mill, when it has sometimes happened that a flame has caught these raised particles, and it has run from one end of the mill to the other and blown it up. That then is on account of the affinity which the cotton has for the oxygen; but suppose I set fire to this piece of cotton which is rolled up tightly; it does not go on burning, because I have limited the supply of oxygen, and the inside is prevented from having access to the oxygen, just as it was in the case of the lead by the oxide. But here is some cotton which has been imbued with oxygen in a certain manner. I need not trouble you now with the way it is prepared; it is called gun-cotton. See how that burns [setting fire to a piece]; it is very different from the other, because the oxygen that must be present in its proper amount is put there beforehand. And I have here some pieces of paper which are prepared like the gun-cotton, and imbued with bodies containing oxygen. Here is some which has been soaked in nitrate of strontia — you will see the beautiful red colour of its flame; and here is another which I think contains baryta, which gives that fine green light; and I have here some more which has been soaked in nitrate of copper,—it does not burn quite so brightly, but still very beautifully. In all these cases the combustion goes on independent of the oxygen of the atmosphere. And here we have some gunpowder put into a case, in order to show that it is capable of burning under water. You know that we put it into a gun, shutting off the atmosphere, with shot, and yet the oxygen which it contains supplies the particles with that without which chemical action could not proceed. Now I have a vessel of water here, and am going to make the experiment of putting this fuse under the water, and you will see whether that water can extinguish it; here it is burning out of the water, and there it is burning under the water, and so it will continue until exhausted, and all by reason of the requisite amount of oxygen being contained within the substance. It is by this kind of attraction of the different particles one to the other that we are enabled to trace the laws of chemical affinity, and the wonderful variety of the exertions of these laws.

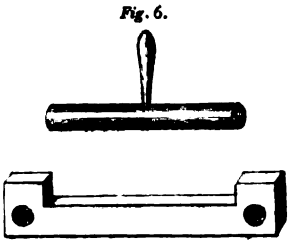
Now I want you to observe that one great exertion of this power which is known as *chemical affinity* is to produce HEAT and light; you know as a matter of fact, no doubt, that when bodies burn they give out heat, but it is a curious thing that this heat does not continue—the heat goes away as soon as the action stops, and you see by that that it depends upon the action *during the time* it is going on. That is not so with gravitation; this force is continuous, and is just as effective in making that lead press on the table as it was when it first fell there. Nothing occurs there which disappears when the action of falling is over; the pressure is upon the table, and will remain there until the lead is removed; whereas, in the action of chemical affinity to give light and heat, they go away immediately the action is over. This lamp *seems* to evolve heat and light continuously, but it is owing to a constant stream of air coming into it on all sides, and this work of producing light and heat by chemical affinity will subside as soon as the stream of air is interrupted. What then is this curious condition of heat? Why it is the evolution of another power of matter, of a power new to us, and which we must now consider as if were the very first time it was brought under our notice. What is heat? We recognise heat by its power of liquefying solid bodies and vapourising liquid bodies, by its power of setting chemical affinity going and very often overcoming it. Then how do we obtain heat? We obtain it in various ways; most abundantly by means of the chemical affinity we have just before been speaking about, but we can also obtain it in many other ways. Friction will produce heat. The Indians rub pieces of wood together until they get them hot enough to take fire, and such things have been known as two branches of a tree rubbing together so hard as to set the tree on fire. I do not suppose I shall set these two pieces of wood on fire by friction; but I can readily produce heat enough to ignite some phosphorus. [The Lecturer here rubbed two pieces of cedar wood strongly against each other for a minute, and then placed on them a piece of phosphorus, which immediately took fire.] And if you take a smooth metal button stuck on a cork, and rub it on a piece of soft deal wood, you will make it so hot as to scorch wood and paper, and burn a match.

Fig. 5.

I am now going to show you that we can obtain heat not by chemical affinity alone, but by the pressure of air. Suppose I take a pellet of cotton and moisten it with a little ether, and put it into a glass tube (*fig.* 5.), and then take a piston and press it down suddenly, I expect I shall be able to burn a little of that ether in the vessel. It wants a suddenness of pressure, or we shall not do what we require. [The piston was forcibly pressed down, when a flame due to the combustion of the ether was visible in the lower part of the syringe.] All we want is to get a little ether in vapour, and give fresh air each time, and so we may go on again and again getting heat enough by the compression of air to fire the vapour of ether.

This then, I think, will be enough, accompanied with all you have previously seen, to show you how we procure heat. And now for the effects of this power. We need not consider many of them on the present occasion, because when you have seen its power of changing ice into water and water into steam, you have seen the two principal results of the application of heat. I want you now to see how it expands all bodies—all bodies but one, and that under limited circumstances. Mr. Anderson will hold a lamp under that retort, and you will see the moment he does so that the air will issue abundantly from the neck which is under water, because the heat which he applies to the air causes it to expand. And here is a brass rod (*fig.* 6.) which goes through that hole and also fits accurately into this gauge; but if I make it warm with this spirit-lamp it will only go in the gauge or through the hole with difficulty; and if I were to put it into boiling water it would not go through at all. Again; as soon as the heat leaves bodies they collapse; see how the air is contracting in the vessel now Mr. Anderson has taken away his lamp: the stem of it is filling with water. And notice now that although I cannot get the tube through this hole or into the gauge, the moment I cool it by dipping it into water, it goes through with perfect facility, so that you see we have a perfect proof of this power of heat to contract and expand bodies.

Fig. 6.



(*The fifth Lecture, on* Magnetism *and* Electricity, *will be given in our next.*)

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS, *Wednesday, Jan.* 18.

Dr. Angus Smith read a paper at the Society of Arts entitled *Science in our Courts of Law*. The communication was very long, but we will endeavour to give our readers some idea of Dr. Smith's views. The doctor thinks that while the position of science is universally recognised, the position of the scientific man is not. He has no status in a court of law, but is allowed to appear under the vague name of a witness; and as such is liable to be cross-examined by an advocate, who is anxious to turn the evidence to the advantage of his client — a course which does not always tend to the elicitation of truth. But it is not right that the scientific man should act as advocate. He ought to be a student of nature, who loves whatever nature says in the most disinterested manner. If he becomes an advocate he is removed from his sphere, and the very ideal of his character is destroyed. Nor is he exactly fitted to be a judge. There is no trial in a court purely scientific. Individual and social rights are always involved, and it does not belong to a "scientist's" province to see the social bearings of a case. He is equally unfitted to act in the capacity of judge and jury united. All law has a tendency to pedantry, that is, a belief in its absolute perfection forgetful of numerous antagonistic possibilities for which a wider observation willingly makes allowance. The jury represents this wider observation of the untrammelled human spirit; and the number is twelve or more instead of one, because the operations of the individual spirit are uncertain; of the average man nearly certain. It represents also the absence of pedantry or the exaggeration of the law, by the absence of legal knowledge. If we put scientific inquirers in their place we increase the pedantry by adding physical to social law. Besides this it is against the principles of the country to give any class of men uncontrolled authority. Nor is Dr. Smith in favour of commissions recommendatory. The power of a scientific commission reporting without being cross examined must be invincible, and consequently a jury would cease to be of value. We must have all the aid of intellect and science, but we refuse its despotism and oppression. When both sides are heard the juryman has the advantage of both arguments; when clear he becomes convinced; when uncertain he has abundant reason for reposing on his perceptions or instincts. A jury of *experts*, the doctor thinks, would introduce too much law and leave out mutual considerations — would increase formal law and diminish instinct — would enlarge the head of the court and leave no room for its heart. Reviewing the position of the scientist as witness at great length, the lecturer advocated the admission of written scientific evidence upon which the witness may be examined and cross-examined if necessary. We gain by this means a clear and full statement which will not be stopped conveniently at every dangerous spot, but will either tell the truth, the whole truth, and nothing but the truth, or leave the witness to take his chance of receiving the character of a perjurer. The lecturer concluded as follows:

"This lecture has been in favour of giving the scientific man an independent position in a court of law. He becomes a court of appeal in himself, used equally by both plaintiff, defendant, and judge. On the one side, the plaintiff has the advantage of his knowledge and opinion, having made him well acquainted with the case, and been instructed in all its relations to science. The same advantage is given to the defendant, whilst an adviser, able by his education to encounter that class of reasoning, is given to the judge. Scientific men are bound together by mutual beliefs in a stronger manner than the community at large, and if put into this honourable and independent position, they will act according to their knowledge and character, and cease much unnecessary contradiction and opposition. Being bound to speak the truth, the whole truth, and nothing but the truth, they will feel in honour bound to do so when an opportunity offers. This opportunity rarely occurs in the present confusion.

My belief is, that no class of men will so fully agree with each other as the scientific, if not kept separate by the present corrupting system, and no class will spread a more beneficial influence over society if not contemptuously compelled to herd with thieves and scoundrels in a witness box. Perhaps this expression is too strong, but it has a side of truth; and I have seen barristers speaking to a scientific witness in a box in such a way as to show that a witness was to them always an inferior personage. This too happens even in cases where the word of the scientific man must of necessity decide the whole case, and where the duty of the barrister is a mere simple formality.

I think a scientific man may well claim for himself such an exemption from insult. You may say that his own character and bearing ought to command respect, but there are few men, if any, in this world, whose treatment by others is entirely unaffected by position.

We have now gone through the main points to be discussed according to this view of the case, and concluded that:—

1st. The scientific man shall not take the place of judge; the study of physical science does not fit a man for that office.

2nd. He shall not take the place of a jury, because the jury represents the instincts and impulses of intelligent freemen acting out the common sense of the community, an element essentially distinct from any physical science.

3rd. He shall not act as a plenipotentiary commission, absorbing judge and jury, for the above reasons.

4th. He shall not act as a recommending commisson, as such is apt to become too powerful, and really does become so in practice. Nos. 3 and 4 are plans of despotic states.

5th. He shall not act as advocate, because he represents fixed law, not the interests of individuals.

6th. If he acts as witness he must be allowed to express his opinion independently of the advocate, or the plaintiff and defendant. Put upon his own honour, he will be able and willing to speak the truth, the whole truth, and nothing but the truth, which is now not permitted him.

7th. He shall assist the judge in examining scientific witnesses, or obtaining scientific evidence as assessor.

8th. That instead of witness he may appear in his own character of scientific man, whose evidence is different from ordinary witnesses, and whose position is capable of being made, to a great extent, independent of the parties in the suit. This allies itself with No. 6.

The Remedies Proposed.—1st. To have a scientific assessor on the bench beside the judge, who shall examine the witnesses, if needful, and who shall advise the judge. That this assessor shall be appointed by the crown. He shall not be questioned as a witness, but sit as assistant judge.

2nd. That a position be given to the scientific man indepen-

dent of the barrister. I am not a lawyer, and do not pretend to adjust the mode of doing this, but I believe it is essential, and must be done sooner or later.

3rd. That scientific men giving evidence on scientific points shall be allowed to deliver their examinations in writing. The reading and elucidation to be controlled by the judge, examination and cross-examination by the barrister to follow. The subject is now arranged ready for your examination. It may be viewed in many ways—indignantly, humorously, and comically. I have endeavoured to view it calmly. The purely legal view must be left to the legal profession. Minute particulars and the practice of foreign states are necessarily left out."

Another suggestion, from the pen of Mr. Wentworth L. Scott, appears in the *Journal of the Society of Arts*. Commenting on the above paper, the writer continues:

"Were these several suggestions carried out something would yet remain to be done, for it must be remembered that a scientific jury is not to be thought of, and one composed of ordinary individuals is somewhat apt to forget (as being partly beyond its comprehension) in consultation various scientific points that have been impressed upon it while in court, or, at least, does not accord to them their full moral power. A very glaring instance of this was exhibited in the late trial of Dr. Smethurst, for (in the opinion now, I believe, of the country at large) if due weight had been given to the chemical and medical evidence, and the same had been properly considered, the verdict would have been different. Now, I would humbly suggest, for the consideration of those who are interested in the subject, that this defect might be remedied in one of the two following ways, viz. either (in all cases likely to require the same) by appointing as one of the jurors a scientific man, capable of giving to the said points their real and just value, and of explaining the same to his colleagues, or by allowing such a person to have access to the jurors, who may gain from him the information they require, while he is restricted to the simple answering of queries, without referring to his personal opinions on the case. Furthermore, ... I should be inclined to suggest that a special committee be formed .... for the purpose of more fully considering the subject of 'Science in our Courts of Law,' and that the barrister, the chemist, and the physiologist be equally represented amongst its members. The functions of such a committee would be various and important; some of the most prominent would be to consider and digest the whole subject in its legal bearings as it now stands; to point out in detail the defects of the present system, and the manner in which these might be most readily and conveniently done away with; to consider carefully the various methods of detecting poisons and adulterations now usually employed, noting the practical desiderata apparent therein; and, finally, to draw up a comprehensive report on the whole, calculated to serve as a basis for a parliamentary bill for amending the position of 'science in our courts of law,' to be brought before both houses."

CHEMICAL SOCIETY, 19 *Jan.* 1860.

PROFESSOR BRODIE, *F.R.S. President, in the Chair.*

AFTER the routine business had been disposed of

The CHAIRMAN stated that that evening being devoted to metallurgical chemistry, he would call upon Mr. Warrington to read his paper *On Refining Gold, when alloyed with Tin or Antimony, so as to render it fit for the purposes of Coinage.* In 1857 Mr. WARRINGTON was called upon to analyse a specimen of Australian bar gold, which was said to have been obtained by the quartz crushing process. Outside it had the appearance of a golden hue, perhaps a little paler than usual; but when it was broken the fractured surfaces were seen to have a crystalline structure of a greyish-yellow colour. It was very brittle, and was found to have the following composition:—

Gold	92·40	
Silver	4·60	
Tin	2·00	with trace of antimony.
Copper	0·75	
	99·75	
Loss	0·25	

Many bars of the same kind had arrived, and had given a good deal of trouble to the refiners and also to the Mint; and 47,000 ounces had been returned to the Bank of England as unfit for the purposes of coinage.

Another specimen which Mr. Warrington received, having much the same appearances and being just as brittle, yielded on analysis:—

Gold	93·80
Silver	2·20
Antimony	2·28
Tin	1·40
Arsenic } Copper }	traces.
	99·68
Loss	0·32

It is evident that the presence of these alloying metals would not be discovered in the ordinary mode of assay by cupellation and quartation, inasmuch as they would be oxidised and carried into the cupel with the lead; and therefore, from the brittleness of the alloy, the subsequent operation of rolling would be impossible.

A question arose as to the origin of these metals: whether they were found associated with the gold, or whether they were introduced during the melting process. Gold and oxide of tin are found associated in stream works both in Ceylon and Cornwall, and a good deal of stream tin is brought from Australia. The presence of tin, therefore, might be anticipated; but how was the antimony in the second specimen to be accounted for? Mr. Warrington's impression was that it was introduced during a rough process of refining by sulphuret of antimony, and that for want of proper management the operation had not been perfectly carried out.

The use of sulphuret of antimony in refining is well known, and it will suffice to say, that if successfully applied it converts the iron, zinc, tin, &c. with some of the silver, into sulphurets, which float on the surface of the gold. Some of the antimony, however, alloys with the gold, and must be removed by a second operation.

To find an inexpensive method of removing these alloying metals without a loss of gold required some consideration, inasmuch as it must be accomplished by a process of oxidation; and yet it was necessary that the oxidising agent should be applied to the gold while in a fluid state, and moreover, that it should not part with its oxygen simply by the heat to which it would be submitted. The use of nitrate of potash had failed, and therefore Mr. Warrington resorted to the employment of metallic oxides having a weaker affinity for oxygen at high temperatures than the metals it was necessary to remove from the gold.

After a few experiments Mr. Warrington determined on the process which he now laid before the Society. It consists in employing about ten per cent of oxide of copper, and a small quantity of borax, which with the alloyed gold must be kept in a well-fused state for half an hour. The result is a perfectly malleable gold containing a small per centage of copper and well fitted for the purpose of coinage. The amount of oxide of copper used must depend on the amount of oxidable metals to be removed; but from the specimens Mr. Warrington examined he thinks the proportion need never exceed ten per cent. Oxide of manganese might be used, but oxide of copper has many advantages over it. So prepared the resulting gold will always be better than standard gold, unless the baser metals are present in large proportion.

The solution of the above specimens in aqua regia deposited beautiful crystals of chloride of silver, and Mr. Warrington mentioned a curious case of the same kind, which had been brought under his notice by Mr. Scanlan. On trying to obtain the gold from a chain of Indian manufacture, by solution in aqua regia, Mr. Scanlan found that it would not dissolve. A little gold was found in solution, but the form and size of the chain remained unaltered. It had, however, become very brittle, and of a brown colour. Examination by the microscope showed what had happened. The chain now consisted almost entirely of chloride of silver, beautifully

crystallised on the surface, and having a radiating structure from the interior to the circumference. In some parts a fragment of the original alloy was found, which had probably been protected from the action of the acid by the chloride of silver formed around it.

In the discussion which followed, a MEMBER stated that sulphuret of antimony occurred in an enormous quantity in the immediate neighbourhood of gold. He had picked out many specimens from the quartz.

Mr. MAKIN said he thought that tin also might be present, and he thought that those bodies — tin and antimony — the latter more especially — would be got rid of in the ordinary refining process. He thought that the refining process with nitrate of potash could not be well employed because the density of liquid gold would prevent its complete action.

Mr. DELARUE stated that it sometimes occurred in their manufactory, that when the sweepings of the floors where gold leaf had been used were melted up, it would occasionally happen that loose type got melted with it. He had himself attempted to remove the antimony during the process of refining, but without success, and it appeared to him that the method suggested by Mr. Warrington had many things to recommend it. The only metal which was introduced into the alloy by that plan was copper, which left the gold in an equally available form, whether it was in excess of the amount in standard gold or not.

Mr. MATTHEY called attention to one point, viz. that if the gold containing antimony were attempted to be purified by the oxide of copper method, in plumbago crucibles, the copper would be reduced to the metallic state by the carbon in the crucible instead of by the oxidation of the antimony. He believed that the purification might be effected by the use of sal-ammoniac; if gold, alloyed with baser metals, were melted with sal-ammoniac, the gold would become quite tough, owing to the sal-ammoniac, during evaporation, taking away the other metals. He thought, therefore, that this was a more simple process than Mr. Warrington's, and one more likely to succeed on the large scale.

The CHAIRMAN asked whether certain specimens of zinc, which were stated to have been found in a metallic form at Bendigo, had been examined.

Mr. PHILLIPS said that he had received a parcel of silver ore from Australia some time ago, which contained several pieces of metallic zinc. It was a question how they got there. He at first thought that they were placed there on purpose; but it might possibly have been native zinc placed there by nature.

The CHAIRMAN said that the specimens of zinc from Bendigo of which he had spoken were so extremely pure that he suspected they were *sowed*, as he knew that the trick of *sowing* gold was commonly resorted to, for the object of raising the price of plots of ground.

Mr. PHILLIPS had met with specimens in an arborescent form, very much resembling arborescent silver, which upon examination were found to be almost pure zinc.

Mr. WARRINGTON in reply to the observations of Mr. Matthey, said that it was certainly fatal to any process of oxidation to operate in a black lead crucible. When the melters came to him, after making a first trial of his proposed method, they said they had been quite unsuccessful, and had not succeeded in rendering the gold in the least malleable. Upon inquiry, he found that they had operated with the plumbago melting pots ordinarily used in their operations, and which were, of course, fatal to any process of oxidation. On performing the operation afterwards in pots fitted for oxidation they succeeded perfectly well. The waste of gold when a large surface is exposed, and where by *burning out* so large a proportion of metal the gold is liable to spurt, was a very heavy loss to the refiner; he had no doubt of the success of the process described in his paper, if properly carried out.

The CHAIRMAN, after expressing the great obligation which the Society was under to Mr. Warrington for his valuable paper, invited Mr. Makin to read his paper *On certain sources of loss of Precious Metals in some operations of Assaying*. When making a large number of assays of gold, and also estimating the silver, under circumstances which required that an extraordinary degree of heat should be employed, Mr. MAKIN was struck with the great loss of gold and silver. Satisfied that it was not entirely owing to "cupel absorption" he examined the contents of the iron flue of the furnace, which had only been used for the cupellation of gold assays, to see if any of the precious metals had been volatilised. Under the microscope the apparently carbonaceous matter from the flue showed yellow masses of oxide of lead, nodules of suboxide of copper, and minute grains of silver mixed with carbonised matter containing small grains of unburnt fuel. On analysis the metallic matters present were found to be oxide of lead mixed with small portions of gold, silver, and oxide of copper. The metals were extracted by lead in the usual way, and the button obtained by scorification was subjected to cupellation. The gold and silver were then parted, and the proportions of each in 1000 grains were found to be:—

Gold	0·087
Silver	0·763

Another source of loss occurs in parting operations and refining on the large scale, from the solution of gold in nitric acid, even when it is quite free from hydrochloric acid, in consequence of the formation of nitrous acid. Mr. Field, the Queen's assay master, had a bottle which was thickly coated with gold deposited from nitric acid which had been used in parting operations. Sir John Herschel thought that the gold might have been suspended in the acid; but the fact that the bottle was pear-shaped, and was uniformly coated with the metal, proved that it must have separated from a solution. To ascertain the amount of loss from this source in ordinary assay operations, Mr. Makin took four specimens of pure gold accurately weighed, added the usual proportions of fine silver and lead, and then cupelled them. The resulting buttons were rolled, coiled, and parted with nitric acid, the cornets being boiled in two acids of different strengths a different number of times. Calling the weighings before the operation 1000, the results were as follows:—

1.	Boiled in acid twice	999·6
2.	„ 3 times	999·2
3.	„ 4 times	998·7
4.	„ 5 times	997·9

The loss is thus seen to increase as the boilings are multiplied.

When silver is present in large quantity, Mr. Makin believes that the solvent action of nitrous acid is restrained by electrical action, the gold becoming the negative and the silver the positive pole of a circuit; but as the silver is removed, the solution of the gold goes on more rapidly. The cause of the evolution of nitrous acid is evident as long as there is any silver present, and it often results from the use of charcoal to prevent "bumping." When charcoal is thoroughly carbonised, it does not materially affect the acid; but if it contain woody matter, nitrous acid is sure to be set free. Mr. Makin has given up the use of charcoal on this account.

The commercial importance of this subject will be admitted, when we remember the enormous value of the metals dealt with in this country, and that the question of profit and loss in commercial transactions with them are almost entirely in the hands of the assayer. A knowledge of these facts may also serve to account for some of the discrepancies between assayers.

The CHAIRMAN stated that Mr. Makin had very much underrated the value of his paper in a commercial point of view. It was well known when platinum was alloyed with silver it was readily dissolved by nitric acid, and the same thing might therefore take place with gold.

Mr. MAKIN thought that the solution of the gold was due to nitrous acid, because the effect seemed to be increased as the silver decreased.

A Member thought that the fact of the volatilisation of of gold and its deposition in the chimney of the furnace was very important. In great smelting works, where the flues are carried up for several miles among the mountains, large deposits of metals are found in them.

The Chairman recollected some lead works which had that description of flue, and he was told as a fact that the whole profit of the works was said to lie in the metal so recovered in the flues.

Mr. Phillips asked Mr. Makin whether he had taken any notice of the absorption of the metal by the cupel, which sometimes amounted to from 5 to 10 per cent., a matter of very great importance in assaying. Being connected with some silver assaying works this subject had frequently been brought under his notice, and he found that the cupel absorption sometimes amounted to as much as 11 per cent. Of course a great deal would depend on the shape of the cupel.

Mr. Makin said that the absorption by the cupel was a fact so well known that he did not think it necessary to mention it. He was very careful on this point, so much so, that he had all his cupels made by the same hand, in order that he might have as little difference of absorption as possible, and this was estimated and allowed for by calculation; but even then it varied sometimes.

The Chairman asked whether Mr. Makin had made any experiments with a view to see whether nitrous acid effected the solution of gold when other foreign metals beside silver were present.

Mr. Makin said he had not at present.

[Owing to the length to which our report extends we are compelled to defer the notice of Mr. Field's communication till next week.—Ed.]

NOTICES OF BOOKS, PATENTS, &c.

Improved Method of obtaining the Metallic Particles contained in Fumes or Vapours from Lead and other Smelting Works. Alfred Courage.

Mr. Courage introduces steam into the flue or flues communicating with the various furnaces, which, mixing with the fumes, causes the deposit therefrom of the metallic particles contained therein or therewith. He claims the introduction of steam into the flues, and the placing of tanks in them to utilise the waste heat in generating the steam.

Improvements in producing Figures or Representations upon Glass. James Napier.

Mr. Napier takes a print, lithograph, or engraving, or design, drawn by hand with printer's ink, and fixes the *printed surface* to the glass by means of ordinary paste, with great care to exclude the air. When perfectly dry, he applies to the paper liquid hydrofluoric acid, specific gravity 1·14 for about three minutes, after which he washes off the paper, and the figure or representation is found on the glass. Of course the printer's ink protects the glass from the action of the acid. Mr. Napier prefers to have the glass finely ground, enamelled or veneered, before he applies his process, when the picture stands out in relief. If the veneer or enamel is coloured, of course the picture remains coloured, and the body of the glass is white. Very pretty effects may no doubt be produced in this way.

Improvements in the purification of Coal Gas. John Leigh.

Mr. Leigh's invention consists in the application of causticised or partially causticised gas water or ammonia water to the purification of coal gas or cannel gas in order to remove from the gas not only the salts of ammonia existing therein, but also the carbonic acid, sulphuretted hydrogen sulphocyanic acid, hydrocyanic acid, &c. which may exist also in the impure gas. He gets his causticised gas or ammonia water by mixing these liquids with slaked lime and agitating the mixture for a considerable time. When the lime is deposited, the clear solution is run off, and pumped to the top of a washing tower, where it is made to fall in a shower or spray upon a number of shelves covered with brickbats or other material exposing extent of surface through which the gas which enters at the bottom is made to pass. The gas, says the inventor, being brought into contact with the causticised ammonia water, imparts to it not only the salts of ammonia which it contains, but also the carbonic acid, sulphuretted hydrogen, sulphocyanic, and hydrocyanic or other acids which may exist in gas as impurities. *But* as some portion of the salts of ammonia *may* be carried forward, these may be removed by passing the gas terminally through one or more purifiers containing layers of any one of the numerous substances capable of removing the salts of ammonia. The inventor desires it to be distinctly understood, that he claims nothing but the use of causticised or partially causticised gas water or ammonia water for the purification of coal or cannel gas.

CORRESPONDENCE.

Druggist's Labels.

To the Editor of the Chemical News.

Sir,—Your correspondent Cui Bono (p. 71) inquires the use of Latin labels. I beg to answer: 1, That they secure intelligence, and preparatory education in chemists and druggists who dispense the medicines so named. 2, That they keep up the profits of the drug trade, and secure for it the cream of middle class young men. 3, That they secure the *faith* of invalids. 4, That they promote scientific literature. Many other reasons I could have urged, but these will probably suffice. It may be safe to use English labels when the multitude understand the character and properties of strychnine as well as they do those of gunpowder, or those of Hyd. Bichlor. as well as the uses of saltpetre; but until then we had better use Latin labels.—I am, &c.

T. S.

Chemical Notices from foreign sources, by Dr. T. L. Phipson.

I. MINERAL CHEMISTRY.

Chrome-green.—M. Guignet[1] has discovered a new method of preparing oxide of chromium fit for colouring purposes. A mixture of 3 parts of boracic acid and 1 part of bichromate of potash is calcined at a temperature of about 500° (Centigrade). An evolution of water and oxygen gas is observed, and there is formed a double borate of sesquioxide of chromium and potash. This salt, which is stable at the ordinary temperature, is decomposed by water, giving bi-borate of potash and sesquioxide of chrome. The latter in the nascent state combines with water, and forms an hydrated sesquioxide of a remarkably fine colour. This is separated from the biborate of potash by decantation and washing, and the resulting chrome-green has been introduction into commerce either as an oil paint or for the use of calico-printers. In the former case it is first dried and then reduced to powder; in the latter it is directly introduced into the bruising machines. This colour is very solid and brilliant, even by artificial light.

Antimoniuretted Hydrogen.—Dr. Hannon, professor at the University of Brussels, has published[2] a note upon the pharmaceutical preparation and administration of antimoniuretted hydrogen. When pure, antimoniuretted hydrogen is a colourless gas, having no odour, and which does not irritate the bronchiæ; it can therefore be introduced

[1] *Le Cosmos*, 30 Déc. 1859.
[2] *Journal de Pharmacologie de Bruxelles*, Jan. 1860.

into the lungs without danger. It burns with a yellow flame, evolving white vapours of oxide of antimony. When a cold body is placed in this flame, a black opaque coating of metallic antimony is deposited upon it. This deposit differs, as is well known, by many characters from a similar one, which is produced by arseniuretted hydrogen. Antimoniuretted hydrogen can be passed through water and through alkaline solutions without decomposition. For therapeutic purposes Dr. Hannon recommends that it should be prepared with 9 grammes of an alloy composed of 6 parts of zinc and 3 parts of antimony. To these 9 grammes are added 3 grammes of tartar-emetic or the same quantity of chloride of antimony. The zinc and the antimony employed must be chemically pure. The above mixture is placed in a flask with a wide neck, and to it is added from hour to hour, when the invalid is to inhale the gas, 2 or 3 grammes of hydrochloric acid until 30 grammes of the latter have been used. As hydrochloric vapours are evolved at the same time, it is necessary to fill the neck of the flask with a sponge containing a solution of potash or soda to arrest the acid vapours. By means of a piece of string attached to it, this sponge is withdrawn after the inhalation has taken place. The antimoniuretted hydrogen is inhaled by the patient for five minutes each hour. After an inhalation has taken place the flask may be left in the room uncorked, that the antimoniuretted gas may mix with the air of the chamber.

II. ORGANIC CHEMISTRY.

On Melampyrin; a new kind of Sugar. — This new immediate principle has been lately studied by M. Eichler.[3] It was formerly obtained in an impure state by Hunefeld. M. Eichler describes three processes by which it may be extracted; the following is the most simple: —

A decoction is prepared with the leaves of *Melampyrum nemorosum*. It is boiled with milk of lime and then filtered. The clear liquid is evaporated, and hydrochloric acid is added until an acid reaction is obtained; the melampyrin is soon deposited in rhomboidal prisms. These crystals are transparent and inodorous; their sweet taste is less marked than that of lactin (sugar-of-milk).

Melampyrin is also found in two other plants that are common enough in our climate, namely, *Scrophularia nodosa* and *Rhinanthus cristagalli*.

The three plants named all contain *succinic acid*, whence it is possible that melampyrin does not exist in these plants in a separate state, but in combination with this succinic acid, forming what is called a *glucoside*. This opinion, however, has not been expressed by M. Eichler.

Melampyrin is very soluble in boiling water, from which a portion is deposited on cooling; 1 part can be dissolved in 25·5 parts of water at +15° (Centigr.), and in 1362 parts of alcohol of 0·835 sp. gr. It is very slightly soluble in acetone, wood-spirit, acetic ether, and chloroform. Completely insoluble in ether, benzin, turpentin, and oil of naphtha. Melts at +186° (Centigr.) without losing any of its weight. Its solutions have no action upon polarised light. It resists boiling with weak potash or dilute sulphuric acid; does not reduce either salts of copper or mercury in presence of potash, and is not changed by a mixture of bichromate of potash and sulphuric acid.

Nitric acid only decomposes melampyrin at boiling point; the products are *oxalic acid* and *mucic acid*. When treated with sulpho-nitric acid melampyrin produces several nitrogenous compounds, which explode slightly when heated, and from which melampyrin can be again obtained by reducing the compound with sulphide of ammonium. Melted at 186° (Centigr.) melampyrin presents a composition which corresponds to the formula: $C_{12}H_{18}O_{18}$, which only differs from mannite by 1 eq. of water. With oxides it forms compounds similar to those formed by mannite and cane-sugar. The baryta compound is $C_{12}H_{16}O_{13}$, $2BaO$, $14HO$; it forms hexagonal prisms, which are very soluble in water and dilute alcohol. By means of this compound and carbonate of ammonia, the corresponding ammonia compound is prepared by double decomposition. It also crystallises in hexagonal prisms.

Finally, melampyrin dissolves in concentrated sulphuric acid, giving a vinic acid, whose baryta salt is very soluble in water, and insoluble in alcohol; its formula is $C_{12}H_{12}O_{10}$, $3BaO$, $6SO_3$.

III. CHEMICAL ANALYSIS.

Separation of Zinc from Nickel or Cobalt. — M. Brunner[4] gives us the following solution of this problem, which was formerly looked upon as one of the most difficult in analytical chemistry — the solution of the two metals (zinc and nickel, or zinc and cobalt) in hydrochloric or nitric acid, is diluted with a large quantity of water, and almost completely neutralised by carbonate of soda. To effect this, a slight excess of the latter is added, and the precipitate which ensues is redissolved in a few drops of acid, so as to introduce a very slight excess of the latter. A current of sulphuretted hydrogen is then made to pass through the liquid, and to complete the precipitation of the zinc, a few drops of a diluted solution of acetate of soda are added to the liquid. Care must be taken not to introduce an excess of acetate, and not to heat the liquid. A fresh current of sulphuretted hydrogen is now allowed to pass, until the precipitate does not appear to increase. The vessel is then left to itself for ten or twelve hours at the ordinary temperature, after which the precipitate is collected in a filter and washed. To make sure that all the zinc has been thrown down, a drop of acetate of soda may be added to a little of the filtered liquid, which should remain clear, when a little sulphuretted hydrogen is introduced. The nickel or cobalt is thrown down from the filtrate by potassa.

If the original solution contain iron, it is essential to separate it first of all by carbonate of baryta, as proposed by Fuchs.

SCIENTIFIC NOTES AND QUERIES.

Magnetic Peroxide of Iron.—Sir,—Perhaps you will allow me to direct the attention of your correspondent, Mr. Robbins (p. 11), to Brande's *Manual of Chemistry*, vol. i. p. 715, where he will find the following remark on peroxide of iron: "When, however, it has been long and strongly heated, portions of it sometimes become magnetic."—*W. G.*

Sir,—At p. 262 of Dr. John M'Culloch's *Essay on Malaria*, a work of authority and much value, published in 1827 by Longman and Co. of London, is the following passage:—"That guns which had been reposing for a century at the bottom of a deep sea, were *red-hot* when brought up to the light of day was as little believed and as much ridiculed as the limitations of the malaria in this case will probably be by the sceptics in question. Yet the investigations of the same credulous person proved its truth, and added a new and interesting fact to chemical science."

Of the curious matter alleged so positively but obscurely in the foregoing quotation, he nowhere else in his work offers either detail, or proof, or explanation; and yet from his character and position he was not a man to make a gratuitous mis-statement. If what he has so enigmatically asserted is indeed a fact, it will well deserve to be added to the number of "The Hot Contradictions."

You will greatly oblige one of your readers and subscribers if you will have the goodness to say whether: 1st, the matter alleged by the doctor is indeed a fact; and, if indeed a fact, in what book an account of it is to be found; and 3rd, what is the explanation of it?—*J. Moorhead.*

[We have never seen the statement except in Dr. M'Culloch's work; but perhaps one of our readers may be able to say what has been the origin of so extraordinary a report.—Ed.]

Ignoramus wishes to know "What are the reasons for considering the formulæ at present given for the acid and other bodies obtained from lichens by Stenhouse as doubtful?"

[3] *Journ. de Pharm. et de Chim.* Août 1859.

[4] *Dingler's Polytech. Journ.* cl. p. 369.

LABORATORY MEMORANDA.

Results of the working of Cod-fish for Fibrin, &c.—Six large fish were taken—the flesh of which carefully separated from the skin, bones, &c. weighed 43 lbs. avoirdupois. The flesh was chopped very fine, kneaded with water and subjected to pressure in the usual way—a process which was repeated several times—by which means was obtained as the final result:

Dry fibrin	4 lbs. 10 ozs. (avoir.)
Dry albumen	10 ozs. ,,
Kreatine	327 grs.
Phosphoric acid	1·589 oz.

The above is not given as an analytical estimation of the above ingredients in the flesh, but merely as the results of a commercial working.—*John Williams.*

MISCELLANEOUS.

Homœopathic Dilutions.—You frequently see in homœopathic writings that the billionth of a drop was used. What is a billion? A million times a million. No man could count a billion. If you counted 200 in a minute, this would be 12,000 in an hour, 288,000 in a day, and 105,120,000 in a year—it would take 9512 years, at the above rate of 200 a minute, to count a billion! And yet this is only the sixth dilution used by homœopaths, viz. the 1,000,000,000,000th of a drop or grain. Some, however, will dilute their medicines to the decillionth part of a drop. We endeavoured to show that the Atlantic Ocean does not contain a decillion of drops, and that the physician might as well drop a drop of laudanum or any other medicine into the sea, and after being *well mixed* take a few drops out and give them to his patient.—*Braithwaite's Retrospect.*

The Fitzmaurice Light and Portable Gas Company.—An exhibition of this new light—the Oxyoleofiant—took place at Conway Lodge, Hyde Park. The light, which is composed of camphor and vegetable oils, has all the softness and brilliancy of gas, without its heat or deleterious effluvia. It can be produced at the price of the ordinary coal gas, and one great advantage in connection with it is that every large establishment or householder can be furnished, at a cost of from 5*l.* to 10*l.* and upwards, with his own gas-making apparatus on his own premises.

Poisoning by Hydrochloric Acid and Chloride of Zinc.—Last week a girl was admitted into the London Hospital who had swallowed about two ounces of the following solution:—hydrochloric acid 4 ozs., water 4 ozs., chloride of zinc 1oz. She died about eighteen hours after drinking the poison. The antidote used was magnesia given in milk at frequent intervals.

Pennsylvania Rock Oil.—In most countries, a troublesome process must be undergone to extract oil from mineral substances, such as from coal and asphalt; but Pennsylvania seems to be so favourably dealt with by Dame Nature that the very rocks distil oil into her lap. The north-western part of that State seems to contain a number of subterranean springs which yield a limpid oil, some of which we have examined. It appears that the Pennsylvania Rock Oil Company purchased the spring of Brewer, William & Co. for the sum of 5000 dollars; and, in 1858, leased it to Mr. E. L. Drake, with the understanding that he should gather the oil at his own expense and pay them 12½ cents a gallon for it. His lease extended for 15 years, with full privilege of working it at his own option. In May last, he commenced looking for salt, and after sinking a shaft 71 feet, on the first of last month, he struck a fissure through which he was boaring, and the discovery of the subterranean spring of oil was the result. The yield per day, up to the period of the recent fire, had increased from 400 to 1600 gallons. The tract of land on which this spring is located was once purchased for a cow, and previously it had been sold at the treasurer's sale for taxes. Now, it is believed, 100,000 dollars would not purchase one acre of it.

The substance known here as Seneca oil, exudes from the rocks, or floats on the surface of springs, in various parts of the world. The name of Seneca oil was derived from the Seneca Indians, a tribe famous in the confederacy known as the Six Nations. The oil in this county was discovered and used by this tribe. A similar oil is found in abundance at Amiano, in Italy; Birmah, on the borders of the Caspian Sea; on the West India Islands, along the shore of the Kanawha, Virginia; in Kentucky; near Seneca Lake, New York; in western Pennsylvania, generally; and in great abundance in Venango county. The wells of Birmah yield 400,000 hogsheads annually. Its uses are almost end less. As a medicine, it is used both externally and internally; is regarded as an excellent stimulating embrocation in chilblains, chronic rheumatism, affections of the joints, paralysis, and kindred complaints. It is an ingredient in the celebrated British oil. It is also used for making an excellent lamp oil, known as Carbon oil, and is considered among machinists as the best lubricator extant.—*Scientific American.*

Starch yielded by different Varieties of Potatoes.—

	Starch.	Fibrous Parenchyma.	Vegetable Albumen.	Gum, Sugar, and Salt.	Water.
Red potato	15·0	7·0	1·4	9·2	75·0
Germinating potatoes	15·0	6·8	1·3	3·7	73·0
Kidney potatoes . .	9·1	8·8	0·8	—	81·3
Large red potatoes .	12·9	6·0	0·7	—	78·0
Sweet potatoes . . .	15·1	8·2	0·8	—	74·3
Peruvian potatoes . .	15·0	5·2	1·9	1·9	76·0
English potatoes . .	12·9	6·8	1·1	1·7	77·5
Parisian potatoes . .	13·3	6·8	0·9	4·8	73·1

The following is an accurate analysis of the potato:—

Water		74
Starch		20
Epidermis, cellular tissue, pectose, pective, pectates of lime, soda, and potash		1·65
Albumen	1·50	
Asparamide	0·12	
Fatty matter	0·10	
Sugar, resin, essential oil	1·07	4·35
Citrate of potash, phosphates of potash, lime, magnesia, silica, and alumina, oxides of iron and manganese	1·56	
		100·00

F. C. Calvert, F.R.S.

Detection of Blood Stains.—M. Brucke has recently published the following method, as being superior to those in common use:—"Wash the spot with cold distilled water. To the reddish liquor thus obtained add a solution of sea salt, and evaporate to dryness, *in vacuo*, over a vessel containing sulphuric acid. Examine the dry residue well through a microscope, in order to verify whether it contains any matter that might be mistaken for Tetchmann's crystals; then add a little highly concentrated acetic acid; evaporate again to dryness; moisten the residue with water; and then, if there really be blood in the spots, the microscope will reveal unmistakable crystals of hæmatin."

ANSWERS TO CORRESPONDENTS.

J. G. (Stourbridge).—We do not know any work which seems to be exactly what our correspondent wishes for.

J. B.—It is much to be regretted that regulations exist which deprive such a deserving case of the assistance of the fund. We will think over the matter, and when space permits perhaps publish our correspondent's letter.

R. J. S.—Not without spoiling the flavour. It must be distilled.

Physeos Zetetes.—1. We do not know the work, but will look at it. 2. Any book on organic chemistry.

An Assistant.—We should be very happy to assist the early closing movement if we could.

Credo.—1. A mixture with acetum scillæ and sesquicarbonate of ammonia is of course "unchemical." 2. You might mention it to the prescriber.

A. B. F.—A saturated solution of sulphate of soda in boiling water, allowed to cool in a flask or bottle from which air is carefully excluded, and then left perfectly still until the experiment is made.

J. Horsley, F.C.S.—Expert—A Member—Oxygen—F.G.—received.

Book received.—Stories of Inventors and Discoveries in Science and the Useful Arts. A Book for Old and Young. By John Timbs, F.S.A.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Phosphoric Acid in Manures, Coprolites, Bone-ash, and similar Commercial Substances, by FRANCIS SUTTON, Norwich.

PHOSPHORIC acid may appropriately be estimated as pyrophosphate of magnesia, basic phosphate of magnesia ($3MgO.PO_5$), phosphate of lead, basic phosphate of iron, phosphate of binoxide of tin, phosphate and pyrophosphate of silver, and lastly as phosphate of uranium.

There can be no doubt that of the above-mentioned forms in which to weigh phosphoric acid, the pre-eminence is generally given to pyrophosphate of magnesia in point of accuracy; but, on the other hand, the difficulties which beset the process in the case of substances mentioned at the head of this paper are so numerous and perplexing, that it is worth while to look for some other method by which the same end can be attained without the expenditure of so much time and trouble.

Without noticing in detail the other processes mentioned, except to say that they are all more or less open to objection, either on the ground of inaccuracy or consumption of time, I will at once come to the last on the list, that is to say, phosphate of uranium, which I believe to be equally accurate with pyrophosphate of magnesia, and far preferable to it in readiness of application and general convenience.

This process was first announced by Leconte[1], since which MM. Arendt and Knop have carefully tested its accuracy and more fully developed the method of application.[2] Fresenius also, in the last German edition of his *Quantitative Analysis*, mentions the process as in every respect satisfactory for the purposes here alluded to. Of the chief advantages connected with the use of salts of uranium as a means of estimating phosphoric acid in phosphates of lime, &c. is that the presence of bases does not interfere with the result. The bases which admit of this mode of determination so far as present experiments have proved, potassa, soda, lime, baryta, magnesia, iron, and alumina; the latter only, however, with modifications of the process as applied to the former. These modifications will be noticed by and by.

In the presence of potassa, soda, magnesia, lime, and alumina the following course must be adopted:—

The substance is to be dissolved if possible in acetic acid; however, this is not to be done, a nitric, hydrochloric or sulphuric acid solution is admissible, taking the caution to avoid any great excess of acid; add soda in excess, and redissolve the precipitate in acetic acid; in the presence of mineral acids it is advisable to add acetate of ammonia as well as acetic acid. Lastly, add a solution of acetate of uranium (best obtained by dissolving pure ammonio-carbonate of uranium in acetic acid) and heat to boiling, by which means the phosphoric acid is completely separated as phosphate of uranium and ammonia.

This precipitate is of a greenish-yellow colour and somewhat slimy in its nature, therefore in order to prevent the pores of the filter from being choked by it, it must be handled in the following manner:—After boiling, set aside on the sand bath, and allow the precipitate to settle; when the supernatant liquid is clear, decant through the filter, pour water over the precipitate and again boil for a few moments; decant as before, taking care that the precipitate has entirely subsided; repeat the process three or four times until the sliminess of the precipitate has given place to a feathery appearance, then pour it out upon the filter and complete the washing in the usual way.

The above process may be hastened somewhat by adding to the liquid in which the precipitate is first suspended, after it has somewhat cooled, a few drops of chloroform; then vigorously stirring the liquid or boiling it up once or twice causes the precipitate to settle more rapidly.

The phosphate of uranium and ammonia thus obtained is totally insoluble in water and acetic acid, but easily so in mineral acids; the addition, however, of a sufficient excess of acetate of ammonia throws it down completely again on boiling. On burning the precipitate the ammonia is driven off, and a lemon-coloured phosphate of sesquioxide of uranium is obtained possessing the formula:

$$2(Ur_2O_3),PO_5$$

If, however, carbon or any reducing gas is present during the burning of the precipitate it is partly reduced to phosphate of protoxide of uranium of a green colour; but on moistening it with nitric acid and again heating the yellow colour of the higher oxide is reproduced.

It is therefore advisable in burning the precipitate to separate it from the filter, first burning the latter, then adding the former, and heating to redness until every trace of carbon is removed. As a precaution against partial reduction it is advisable in all cases to moisten the precipitate when cool with nitric acid and again heat to redness. The burning may take place in an open platinum crucible, and as the precipitate is not easily hygroscopic it may be weighed uncovered.

If it should be necessary to redissolve the precipitate in order to estimate the phosphoric acid afresh, the solution must first be preceded by smelting the precipitate with a considerable excess of carbonate of soda so as to convert the pyrophosphoric into tribasic phosphoric acid.

The composition of the phosphate of uranium is as follows:—

		Per cent.
$2Ur_2O_3$	285·6	80·01
PO_5	71·0	19·99
	356·6	100·00

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[1] *Jahresbericht*, von Liebig und Kopp für 1853, p. 642.
[2] *Centralblatt*, 1856, 769, 803, und 1857, 162, 177.

Therefore one fifth of the precipitate may be calculated as phosphoric acid.

During the past year I have used this process for the determination of phosphoric acid in guanos, the so-called superphosphates of lime, bone-ash, coprolite, &c. in above a hundred analyses, and in many of them controlled the results by other methods, without one instance of inaccuracy or failure. In the more delicate process of urinary analysis I have found it equally reliable.

In a future number will be given the modifications of the process necessary in the presence of oxides of iron and alumina.

TECHNICAL CHEMISTRY.

Extracting Silver from its Ores.

THE processes now in use at the reduction works of the Sonora Exploring and Mining Company, for the extraction of silver from the ores, are essentially three, viz.: smelting, amalgamation in barrels, and amalgamation in the open air, or the *patio* process. They are briefly described by Mr. F. Brunckow, who has recently returned from Arizona, in a report to a committee of the stockholders, from which the following is in part extracted:

The ores of the Heintzelman vein, as well as most of the Mexican ores, contain a considerable portion of quartz, which renders them difficult to smelt. The richest portions only are therefore selected for the smelt-process.

The lower part of the furnace is built of a fine-grained refractory quartzose sandstone found in the neighbourhood. The upper part and the smelting-house are built of brick, dried in the sun and air, called *adobes*. The smelting chamber inside the furnace is twelve inches square, and the blast is produced by a double bellows constructed at the place and worked by one man.

To each part of selected silver ore, three parts of lead ore from the Arenilla mines are added, and after complete fusion the contents of the chamber are allowed to run off into a basin on the outside. As it cools, a crust is formed on the surface, which contains to a large extent sulphurets of copper, lead, and the impurities. This is taken from the lead below and kept separate. The lead is run into castings in the form of cakes, ten inches in diameter, weighing 75 pounds. Six of these lead cakes are put on edge, one near the other, upon two inclined iron plates, which nearly touch each other. Charcoal is placed around and between the cakes, so that they are enveloped, and after kindling it the lead cakes must be protected from draughts of air. The heated cakes commence to melt and sink, and the lead runs down the iron plates to a basin, from which it is run into pigs. The lead is free from copper, and yields about 40 pounds of silver to the ton. A skeleton of each lead cake is left behind on the iron plates, and is rich in copper, and yields some silver. In order to separate this from the copper, the skeleton is broken into fragments and passed the furnace in company with the crusts taken from the lead in the first place, and with some other lead ore. By smelting the skeletons and crusts, which contain sulphurets, &c. lead will result, which is put in castings in the form of cakes; these cakes are put again upon the inclining plates, and pass through the process described before. The remaining skeletons this time contain very little silver; they are smelted in a copper refining reverberatory furnace and refined, and in the form of balls of metallic copper are delivered over to the amalgamation works, where they are required for the barrel process.

The argentiferous lead, free from copper, is put in a cupellation furnace, and passes the well-known oxydating process; the silver remains, and is refined. The resulting oxide of lead is added to the lead and silver ore, and again passes the blast furnace.

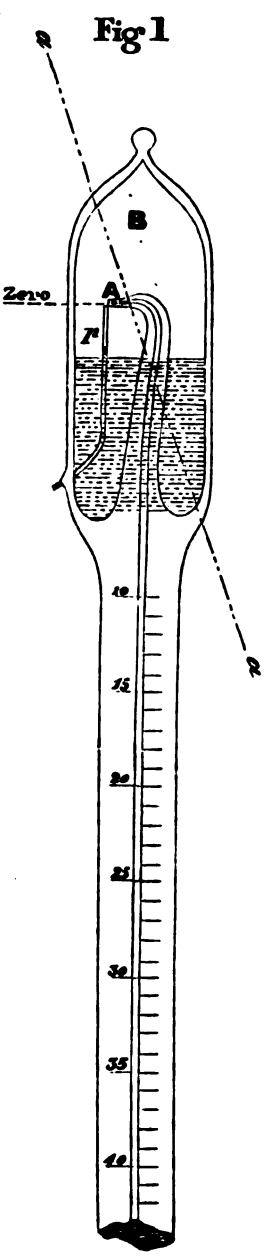
To prepare the ore for amalgamating in barrels, it is crushed by stamps, and passed through three sieves. The siftings of the first sieve are put under the stamps again. The sifting of the second sieve is as fine as grains of wheat, and the total sifting is delivered to the ore-mill, Arastra, where it is ground with water to a very fine powder; then it is dried and crushed. The sifting of the third sieve gives a powder fine as flour. This powder and the obtained fine-ore powder of the Arastra mill is mixed with 8 per cent. common salt, put in a reverberatory roasting furnace, and roasted till all the metals are formed into chlorides; this process is completed in 5 hours. Eight hundred pounds of this powder are put into the amalgamation barrel, together with a certain quantity of water and 75 pounds of the copper balls from the smelting furnaces. The barrels are then made to revolve, so that the whole mass in the barrel will form, after a certain time, a paste so stiff that the 400 pounds of quicksilver now added will not remain in a separate mass at the bottom, but will be divided through the whole body of ground ore in minute globules, unseen by the naked eye. The barrels are now made to revolve for 22 hours. The formed chloride of silver will be precipitated into metallic silver by the presence of the metallic copper; chloride of copper will be formed, and this will be lost. The silver in the metallic state in contact with the quicksilver then forms the amalgam. After 22 hours, more water is put in the barrels, in order to thin the paste, and to accumulate the minutest globules of quicksilver and the formed amalgam in a mass. This will be accomplished in 2 hours, by allowing the barrels to revolve slowly. The barrels are now opened, and the quicksilver and amalgam runs out in troughs, from whence it is put into strong canvas bags. The surplus quicksilver is pressed through the bags by its own weight; the remaining stiff amalgam is retorted; the silver, not being volatile, remains, and is melted, and cast into bars. The bars are marked with the company's stamps, numbered, their fineness according to the assay, and their value in dollars marked upon them.—*American Mining Magazine.*

The Compensation Self-registering Maximum Thermometer of Mr. WENTWORTH L. SCOTT.

THIS very ingenious instrument "consists of a glass tube, with a cylindrical bulb, containing mercury (as in the ordinary thermometer), at its lower extremity; but at the top the stem is drawn out into a fine jet, bent at right angles, A in the interior of the second bulb, B; this upper bulb is about half filled with mercury, the remaining space being a vacuum; near its base a platinum wire, *p*, is welded into the glass, and bent upwards, so that its point is nearly in contact with that of the jet. It is obvious that when the instrument is 'set,' *i. e.* the lower bulb and capillary tube to the point of the jet, completely filled with mercury—any rise of temperature will expand the mercury and cause it to overflow in minute globules into the reservoir above. The platinum wire is simply for the purpose of preventing the forma-

tion of large drops at the point of the jet, by its superior attraction for the fluid metal. Upon cooling, the mercury now remaining will, of course, sink in the tube. The instrument is so graduated that if it were cooled to zero Fahr. the level of the mercury would precisely indicate the highest temperature to which it had been previously exposed; but if the observation were made at the atmospheric temperature, the mercury would stand exactly as much higher in the tube, *i. e.* lower in the scale—as the temperature of the air was above zero Fahr.; therefore, to ascertain the maximum temperature, it is only necessary to add to the degree at which the mercury stands the temperature at the time the observation is made. Thus, supposing the 'compensation' thermometer marks 35 deg., and an ordinary instrument by its side is at 50 deg., 85 deg. will be the highest temperature that has occurred since the last observation. To 'set' this thermometer, the lower bulb must be gently raised, until the mercury runs down the tube into the reservoir-bulb; when contact has been thus established between the two portions of the metal, the reservoir-bulb is slightly elevated, care being taken to keep the point of the glass jet under the surface of the metal (the dotted line *a a* in the diagram, " represents the level of the mercury during this operation). The mercury will now flow back into the lower bulb, and refill the small vacuum produced by the previous decantation, when, upon restoring the instrument to its original vertical position, the tube will be full to the extreme point of the jet."

Fig 1



This thermometer is especially adapted, and indeed was designed, for deep-sea observations. No motion can in the slightest degree affect its accuracy, for no moveable indices are employed, and when the mercury has once passed out of the jet it can only return when the instrument is placed in the position just described.

When used for deep-sea experiments the thermometer is placed in a gun metal tube, over which a cap of the same metal is tightly screwed.

PHARMACY, TOXICOLOGY, &c.

A new Method of estimating the Quinine in Cinchona Barks, by MM. Glenard *and* Guillermond.[1]

The therapeutical as well as the commercial value of a cinchona bark depends on the amount of quinine it contains. A great variety of barks are found in commerce which differ considerably in the quantity of the alkaloid they yield. It is very necessary therefore that every one who buys cinchona barks should know how their value may be tested.

Many methods have been given for estimating the amount of quinine in a bark, but all are tedious and dificult of execution, and consequently require more time and skill than many who are interested in knowing the value of a bark can give to the experiment. The authors therefore endeavoured to find out a method of analysis which should be exact, rapid, and so simple as to be practicable by every one; and they have invented a volumetric method which they believe is perfectly successful.

To extract the quinine they take 100 grains of the bark, place it in a porcelain capsule, add enough hot water to moisten the powder, and then leave it to swell. After some minutes they add by degrees the same weight of lime in fine powder, and then enough water to form a sort of paste, which must be well mixed by stirring with a glass pestle. The lime penetrates the bark, and by decomposing the salts of quinine sets the alkaloid free. The mixture is now thoroughly dried in a water bath, after which the quinine is dissolved out by a known quantity of pure anhydrous ether. Ether is chosen as the solvent, because it dissolves but a very small quantity of cinchonine, and has no action on the colouring matter or other principles in the bark.

To determine the amount of quinine in this etherial solution, the authors add a measured quantity of dilute sulphuric acid of known strength, and then shake the bottle strongly to bring the two well in contact. The quinine passes into the acid liquid, and is changed into sulphate, and at the same time a proportionate amount of acid is neutralised and disappears. To estimate the quinine, it suffices to know the amount of acid combined, or the quantity which remains free. This is found by means of a standard solution of ammonia, made of such a strength that one volume shall exactly saturate an equal volume of the acid. The acid liquid may be coloured with litmus and then the ammonia should be added from a burette: and when the point of saturation is attained, it is easy to see by the quantity of ammonia remaining in the burette the amount of sulphuric acid which has combined with the quinine, and from these data the proportion of the alkaloid contained in the bark may be calculated.

This method, the authors think, realises the conditions of rapidity, precision, and easy execution, they had in view, since by its means any one not used to chemical operations may in less than an hour estimate the value of any bark. Quinometry, they say, presents no more difficulty than alkalimetry.

Many objections to the process have already been made. It has been said, that the equivalent of sulphuric acid being very small in relation to that of the quinine, a small error in the valuation of the acid solution will involve a grave mistake in the sum total of quinine.

[1] Abridged from the *Journal de Pharmacie et de Chimie*, Jan. 1860.

This objection is evidently not serious. It is easy by operating with care to avoid being deceived.

It has also been said that *quinidine* is so soluble in ether, that it may be the cause of a serious mistake — so much so that a bark which does not contain any *quinine* at all may be estimated to furnish three per cent. This might be true if barks usually contained quinidine. In that case the process would certainly give false indications. But does quinidine really exist ready formed in the bark? is it necessarily given birth to every time the bark is submitted to solar action? The authors do not think it. Although the salts of quinine exposed in a glass or capsule to the direct rays of the sun may change into quinidine, it does not follow that the same alteration is produced by the same influence on the quinine contained in vegetable pores and cells. At the most they believe that this modification takes place at the points where the tissue of the bark has been torn; but then the production of quinidine is so inconsiderable in relation to the mass that the presence of the alkaloid in the liquid analysed will not sensibly influence the results of the analysis. They believe still less in the pre-existence of quinidine in the bark — having many times sought for it in vain; and think that this want of success is attributable to the process used for extraction, which does not expose the bark to long manipulations, and so preserves the quinine from the alteration.

The last objection is drawn from the constant presence of cinchonine in the cinchona barks, which not being completely insoluble in ether may involve some error. This is a more serious objection than the preceding. But at the most the cinchonine in the etherial solution can never exceed 0·45 per cent., and when yellow barks are operated on the error ought to be much less, because these barks ordinarily contain very little cinchonine.

If, however, because of the cinchonine, the method does not afford an absolutely correct valuation, it must be confessed that it gives a relative result in a manner more precise, more rapid, and more easily than any other process. A bark which shows 2·5, 3·0, or 3·4 per cent. is certainly and necessarily better, and will contain more quinine than that which shows only 1·0, or 1·2. Their experiments have proved to the authors that barks which yield 3·0 per cent. of quinine are rare in commerc, whilst those which give only 1·2 are abundant.

Adulteration of Rhubarb.[1]

In France as well as in England the powder of Turkey rhubarb it seems, is extensively adulterated with that of the home grown root. M. E. Billot gives a method for detecting this adulteration, which if successful, is certainly very simple. Place a little of the suspected rhubarb in a glass, or on a plate, and drop on it two or three drops of some essential oil, either bergamot, aniseed, or fennel, then add a little magnesia, and rub them together for three or four minutes. If the rhubarb be pure Turkey or Russian, the powder remains of a yellowish colour: but if it contain a mixture of French (Rheum rhaponticum) it assumes a tint which will vary from a salmon to the brightest rose-colour, according as there is little or much of the adulterating ingredient. We can by this means, says M. Billot, discover the least trace of fraud, and the test can be used by anybody, as it requires neither study, nor manipulatory skill.

[1] *Science pour Tous.*

The Comparative Value of different Species of Aconite.[1]

The various species of aconite, like the various species of cinchona, are known to contain different proportions of the active principle. The *aconitum paniculatum* is found to possess the least, and the *aconitum napellus* which resembles in all points, in its botanical characters as well as its energetic properties, the *aconitum ferox* of the Himalaya is found to yield the most aconitine.

The alcoholic extract furnished by an equal weight of fresh leaves of the two sorts differ notably. The *aconitum paniculatum* yields a third more product; but the extract of the aconitum napellus furnishes a considerable quantity of aconitine, while that of the paniculatum gives only a trace. The aqueous extract of the aconitum napellus is almost inert, the reason being that *tannate of aconitine*, which water alone will not dissolve, is formed in the marc during the preparation of the extract.

[1] *Répertoire de Pharmacie*, Nov. 1859.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures[1] *(adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i. e. of such as are called the Physical or Inorganic Forces — including an Account of their Relations to each other; by* M. Faraday, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

Lecture V. (Jan. 6, 1860). *Magnetism—Electricity.*

I wonder whether we shall be too deep to-day or not. Remember, that we spoke of the attraction by gravitation of *all* bodies to all bodies by their simple approach. Remember, that we spoke of the attraction of particles of the *same* kind to each other,—that power which keeps them together in masses,—iron attracted to iron, brass to brass, or water to water. Remember, that we found, on looking into water, that there were particles of two different kinds attracted to each other; and this was a great step beyond the first simple attraction of gravitation; because here we deal with attraction between *different* kinds of matter. The hydrogen could attract the oxygen and reduce it to water, but it could not attract any of its own particles, so that there we obtained a first indication of the existence of *two* attractions.

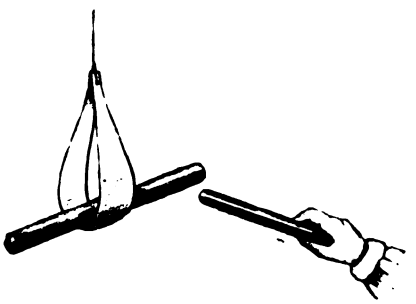
To-day we come to a kind of attraction even more curious than the last, namely, the attraction which we find to be of a double nature—of a curious and dual nature. And I want first of all to make the nature of this doubleness clear to you. Bodies are sometimes endowed with a wonderful attraction, which is not found in them in their ordinary state. For instance, here is a piece of shellac, having the attraction of gravitation, having the attraction of cohesion, and if I set fire to it, it would have the attraction of chemical affinity to the oxygen in the atmosphere. Now all these powers we find *in* it as if they were parts of its substance; but there is another property which I will try and make evident by means of this ball, this bubble of air [a light india-rubber ball, inflated and suspended by a thread]. There is no attraction between this ball and this shellac at present; there may be a little wind in the room slightly moving the ball about, but there is no attraction. But if I rub the shellac with a piece of flannel [rubbing the shellac, and then holding it near the ball], look at the attraction which has arisen out of the shellac, simply by this friction, and which I may take away as easily by drawing it gently through my hand. [The Lecturer repeated the experiment of exciting the shellac, and then removing the attractive power by drawing it through his hand.] Again you will see I can repeat this experiment with another substance; for if I take a glass rod and rub it with a piece of silk covered with what we call amalgam, look at the attraction which it has, how it draws the ball towards it; and then, as before, by quietly rubbing it through the hand, the attraction will be all removed again to come back by friction with this silk.

But now we come to another fact. I will take this piece of shellac, and make it attractive by friction; and remember that

[1] Reported verbatim by special permission.

whenever we get an attraction of gravity, chemical affinity, adhesion, or electricity (as in this case), the body which attracts is attracted also, and just as much as that ball was attracted by the shellac, the shellac was attracted by the ball. Now I will suspend this piece of excited shellac in a little paper stirrup, in this way, (*fig.* 1.) in order to make it move easily, and I will take another

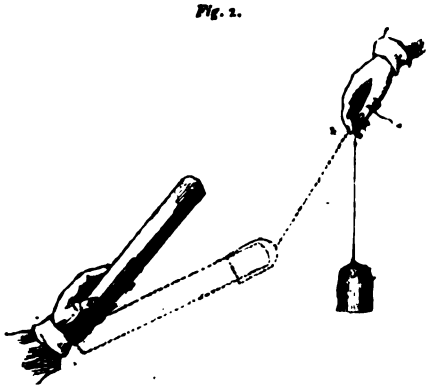
Fig. 1.



piece of shellac, and after rubbing it with flannel, will bring them near together: you will think that they ought to attract each other, but now what happens? It does not attract; on the contrary, it very strongly *repels*, and I can thus drive it round to any extent. These, therefore, repel each other, although they are so strongly attractive—repel each other to the extent of driving this heavy piece of shellac round and round in this way. But if I excite this piece of shellac as before, and take this piece of glass and rub it with silk and then bring them near, what think you will happen? [The Lecturer held the excited glass near the excited shellac, when they attracted each other strongly.] You see, therefore, what a difference there is between these two attractions,—they are actually two *kinds* of attraction concerned in this case, quite different to anything we have met with before; but the *force* is the same. We have here then a double attraction—a dual attraction or force—one attracting and the other repelling.

Again, to show you another experiment which will help to make this clear to you. Suppose I set up this rough indicator again [the excited shellac suspended in the stirrup]; it is rough, but delicate enough for my purpose; and suppose I take this other piece of shellac, and take away the power, which I can do by drawing it gently through the hand; and suppose I take a piece of flannel (*fig.* 2.) which I have shaped into a cap for it,

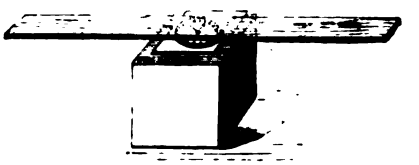
Fig. 2.



and made dry. I will put this shellac into the flannel, and here comes out a very beautiful result. I will rub this shellac and the flannel together (which I can do by twisting the shellac round), and leave them in contact; and then if, I ask, by bringing them near our indicator, what is the attractive force?—it is nothing! But if I take them apart, and then ask what will they do when they are separated,—why the shellac is strongly repelled, as it was before, but the cap is strongly attractive; and yet if I bring them both together again, there is no attraction—it has all disappeared [the experiment was repeated]. Those two bodies therefore still contain this attractive power—when they were parted it was evident to your senses that they had it, though they do not attract when they are together.

This then is sufficient in the outset to give you an idea of the nature of the force which we call ELECTRICITY. There is no end to the things from which you can evolve this power. When you go home take a stick of sealing-wax—I have rather a large stick, but a smaller one will do—and make an indicator of this sort (*fig.* 3.)

Fig. 3.



Take a watch glass (or your watch itself will do, you only want something which shall have a round face), and now if you place a piece of flat glass upon that, you have a very easily moved centre; and if I take this lath and put it on the flat glass (you see I am searching for the centre of gravity of this lath, I want to balance it upon the watch glass), it is very easily moved round, and if I take this piece of sealing-wax and rub it against my coat, and then try whether it is attractive [holding it near the lath], you see how strong the attraction is; I can even draw it about. Here then you have a very beautiful indicator, for I have with a small piece of sealing-wax and my coat pulled round a plank of that kind, so you need be in no want of indicators to discover the presence of this attraction. There is scarcely a substance which we may not use. Here are some indicators (*fig.* 4.) I bend round a strip of paper into a hoop and

Fig. 4.

we have as good an indicator as can be required; see how it rolls along, travelling after the sealing-wax. If I make them smaller, of course we have them running faster, and sometimes they are actually attracted up into the air. Here also is a little collodion balloon. It is so electrical that it will scarcely leave my hand unless to go to the other. See how curiously electrical it is; it is hardly possible for me to touch it without making it electrical; and here is a piece which clings to anything it is brought near, and which it is not easy to lay down. And here is another substance, gutta-percha, in thin strips; it is astonishing how by rubbing this in your hands you make it electrical; but our time forbids us to go further into this subject at present; you see clearly there are two kinds of electricities which may be obtained by rubbing shellac with flannel or glass with silk.

Now, there are some curious bodies in nature (of which I have two specimens on the table) which are called *magnets* or *loadstones*; ores of iron, of which there is a great deal sent from Sweden. They have the attraction of gravitation, and attraction of cohesion, and certain chemical attraction; but they also have a great attractive power, for this little key is held up by this stone. Now, that is not chemical attraction, it is not the attraction of chemical affinity, or of aggregation of particles, or of cohesion, or of electricity (for it will not attract this ball if I bring it near it), but it is a separate and dual attraction, and what is more, one which is not readily removed from the substance, for it has existed in it for ages and ages in the bowels of the earth. Now we can make artificial magnets (you will see me to-morrow make artificial magnets of extraordinary power). And let us take one of these artificial magnets, and examine it, and see where the power is in the mass, and whether it is a dual power. You see it attracts these keys, two or three in succession, and it will attract a very large piece of iron. That then is a very different thing indeed to what you saw in the case of the shellac, for *that* only attracted a light ball, but here I have several ounces of iron held up. And if we come to examine this attraction a little more closely, we shall find it presents some other remarkable differences; first of all, one end

of this bar (*fig.* 5.) attracts this key, but the middle does not attract. It is not then the *whole* of the substance which attracts. If I place this little key in the middle it does not adhere; but if I place it *there*, a little nearer the end, it does, though feebly. Is it not then very curious to find that there is an attractive power at the extremities which is not in the middle!—to have thus in one bar two places in which this force of attraction resides. If I take this bar and balance it carefully on a point, so that it will be free to move round, I can try what action this piece of iron has on it. Well, it attracts one end, and it also attracts the other end, just as you saw the shellac and the glass did, with the

Fig. 5.

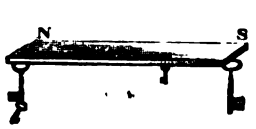
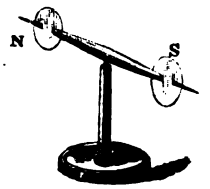


Fig. 6.



exception of its not attracting in the middle. But if now, instead of a piece of iron, I take a *magnet*, and examine it in a similiar way, you see that one of its ends *repels* the suspended magnet; the force then is no longer attraction but repulsion; but, if I take the other end of the magnet and bring it near, it shows attraction again.

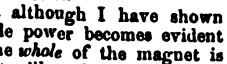
You will see this better, perhaps, by another kind of experiment. Here (*fig.* 6.) is a little magnet, and I have coloured the ends differently so that you may distinguish one from the other. Now this end (. . . .) of the magnet (*fig.* 5.) attracts the *uncoloured* of the little magnet. You see it pulls it towards it with great power. And as I carry it round, the uncoloured end still follows. But now if I gradually bring the middle of the bar magnet opposite the uncoloured end of the needle, it has no effect upon it, either of attraction or repulsion, until, as I come to the opposite extremity (. . . .) you see that it is the *coloured* end of the needle which is pulled towards it. We are now therefore dealing with two kinds of power, attracting different ends of the magnet—a double power, already existing in these bodies, which takes up the form of attraction and repulsion. And now when I put up this label with the word MAGNETISM, you will understand that it is to express this double power.

Now with this loadstone you may make magnets artificially. Here is an artificial magnet (*fig.* 7.) in which both ends have been brought together in order to increase the attraction. This mass will lift that lump of iron, and what is more, by placing this *keeper*, as it is called, on the top of the magnet, and taking hold of the handle it will adhere sufficiently strongly to allow itself to be lifted up, so wonderful is its power of attraction. If you take a needle, and just draw one of its ends along one extremity of the magnet, and then draw the other end along the other extremity, and then gently place it on the surface of some water (the needle will generally float on the surface, owing to the slight greasiness communicated to it by the fingers) you will be able to get all the phenomena of attraction and repulsion, by bringing another magnetised needle near to it.

Fig. 7.

I want you now to observe that although I have shown you in these magnets that this double power becomes evident principally at the extremities, yet the *whole* of the magnet is concerned in giving the power. That will at first seem rather strange, and I must therefore show you an experiment to prove that this is not an accidental matter, but that the whole of the mass is really concerned in this force, just as in falling the whole of the mass is acted upon by the force of gravitation. I have here (*fig.* 8.) a steel bar, and I am going to make it a magnet, by rubbing it on the large magnet (*fig.* 7.) I have now made the two ends magnetic in opposite ways. I do not at present know one from the other, but we can soon find out. You see when I bring it near our magnetic needle (*fig.* 6.) one end repels and the

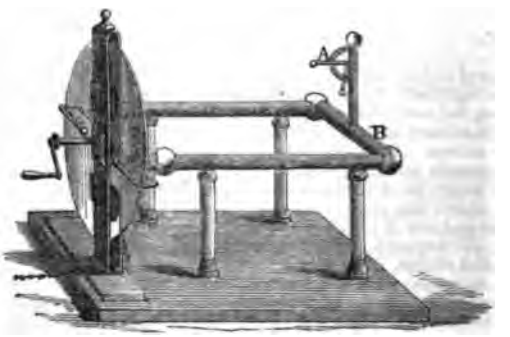
Fig. 8.



other attracts; and the middle will neither attract nor repel—it *cannot*, because it is *half way between the two ends*. But now, if I break out that piece (n. s.) and then examine it—see how strongly one end (n) pulls at this end (s *fig.* 6.) and how it repels the other end (N). And so it can be shown that every part of the magnet contains this power of attraction and repulsion, but that the power is only rendered evident at the end of the mass. You will understand all this in a little while, but what you have now to consider is that every part of this steel is in itself a magnet. Here is a little fragment which I have broken out of the very centre of the bar, and you will still see that one end is attractive and the other is repulsive. Now, is not this power a most wonderful thing? And very strange, the means of taking it from one substance and bringing it to other matters. I cannot make a piece of iron or anything else heavier or lighter than it is; its cohesive power it must and does have; but, as you have seen by these experiments, we can add or subtract this power of magnetism, and almost do as we like with it.

And now we will return for a short time to the subject treated of at the commencement of this lecture. You see here (*fig.* 9.)

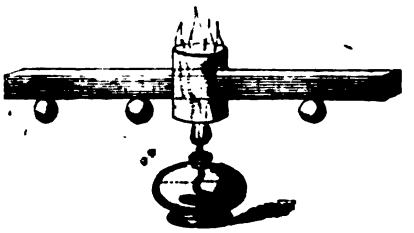
Fig. 9.



a large machine got up for the purpose of rubbing glass with silk and for obtaining the power called *electricity;* and the moment the handle of the machine is turned a certain amount of electricity is evolved, as you will see by the rise of the little straw indicator (. . . .) Now I know from the appearance of repulsion of the pith ball at the end of the straw that electricity is present in those brass conductors (. . .), and I want you to see the manner in which that electricity can pass away [touching the conductor (. . .) with his finger, the Lecturer drew a spark from it, and the straw electrometer immediately fell]. There, it has all gone; and that I have really taken it away you shall see by an experiment of this sort. If I hold this cylinder of brass by the glass handle and touch the conductor with it I take away a little of the electricity. You see the spark in which it passes, and observe that the pith ball indicator has fallen a little, which seems to imply that so much electricity is lost; but it is not lost, it is here in this brass, and I can take it away and carry it about, not because it has any substance of its own, but by some strange property which we have not before met with as belonging to any other force. Let us see whether we have it here or not. [The Lecturer brought the charged cylinder to a jet from which gas was issuing; the spark was seen to pass from the cylinder to the jet, but the gas did not light.] Ah! the gas did not light, but you saw the spark; there is perhaps some draught in the room which blew the gas on one side, or else it would light; we will try this experiment afterwards. You see from the spark that I can transfer the power from the machine to this cylinder, and then carry it away and give it to some other body. You know very well as a matter of experiment that we can transfer the power of heat from one thing to another; for if I put my hand near the fire it gets hot. I can show you this by placing before us this ball which has just been brought red-hot from the fire. If I press this wire to it some of the heat will be transferred from the ball, and I have only now to touch this piece of gun-cotton with the hot wire and you see how I can transfer the heat from the ball to the wire and from the wire to the cotton. So you see that some powers are transferable and others are not. Observe how long the heat stops in this ball. I might touch it with the wire, or with my finger, and if I did so quickly, I should merely burn the surface of the skin; whereas if I touch that cylinder however rapidly with my finger the electricity is gone at once—dispersed on the instant, in a manner wonderful to think of.

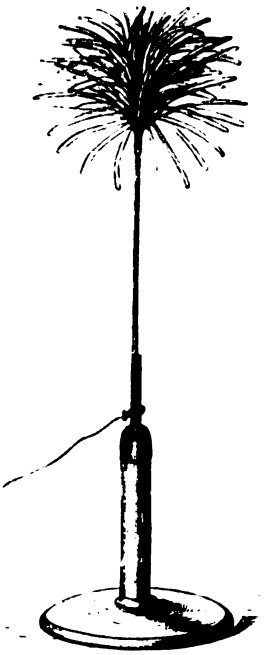
ust now take up a little of your time in shewing you the
er in which these powers are transferred from one thing to
er; for the manner in which *force* may be conducted or
nitted is extraordinary, and most essential for us to under-
. Let us see in what manner these powers travel from
to place. Both heat and electricity can be conducted; and
s an arrangement I have made to shew how the former can
. It consists of a bar of copper (*fig.* 10.) and if I take a

Fig. 10.



lamp (this is one way of obtaining the power of heat) and
t under that little chimney, the flame will strike against
: of copper and keep it hot. Now you are aware that
is being transferred from the flame of that lamp to the
and you will see by and by that it is being conducted
he copper from particle to particle; for, inasmuch as I
astened these wooden balls by a little wax at particular
es from the point where the copper is first heated, first
I will fall and then the more distant ones, as the heat
along, and thus you will learn that the heat travels
lly through the copper. You will see that this is a very
onduction of power as compared with electricity. If I
linders of wood and metal joined together at the ends and
piece of paper round and then apply the heat of this lamp
place where the metal and wood join, you will see how the
ll accumulate where the wood is, and burn the paper with
have covered it; but where the metal is beneath, the heat
ncted away too fast for the paper to be burned. And
ike a piece of wood and a piece of metal joined together,
it so that the flame shall play equally both upon one and
er, we shall soon find that the metal will become hot
ie wood; for if I put a piece of phosphorus on the wood,
ther piece on the copper, you will find that the phosphorus
opper will take fire before that on the wood is melted;
shows you how badly the wood conducts heat. But
ard to the travelling of electricity from place to place
ity is astonishing. I will, first of all, take these pieces
and metal, and you will soon understand how it is that
does not lose the power which it acquired when it is
by the silk; by one or two experiments I will show
I take this piece of brass and bring it near the ma-
ou see how the electricity leaves the latter and passes
ass cylinder. And again, if I take a rod of metal and
e machine with it I lower the indicator, but when I
with a rod of glass no power is drawn away, showing
t the electricity is conducted by the glass and the
a manner entirely different; and to make you see
e clearly we will take one of our Leyden jars. Now,
not embarrass your minds with this subject too much,
take a piece of metal and bring it against the knob
p and the metallic coating at the bottom you will see
ricity passing through the air as a brilliant spark. It
sensible time to pass through this, and if I were to take
etallic wire, no matter what the length, at least as far
concerned; and if I make one end of it touch the out-
the other touch the knob at the top—see how the
r passes!—it has flashed instantaneously through the
ngth of this wire. Is not this different from the trans-
f heat through this copper-bar, (*fig.* 10.) which has taken
of an hour or more to reach the first ball?
s another experiment, for the purpose of shewing the
ility of this power through some bodies and not through
Why do I have this arrangement made of brass?
: to the brass work of the electrical machine, *fig.* 9.]
t conducts electricity. And why do I have these columns
lass? Because they obstruct the passage of electricity.
do I put that paper tassel (*fig.* 11.) at the top of the
n a glass rod, and connect it with this machine by
a wire? You see at once that as soon as the handle of the machine is turned the electricity which is evolved travels along this wire and up the wooden rod, and goes to the tassel at the top, and you see the power of repulsion with which it has endowed these strips of paper, each spreading outwards to the ceiling and sides of the room. The outside of that wire is covered with gutta-percha; it would not serve to keep the force from you if you touched it with your hands, because it would burst through, but it answers our purpose for the present. And so you see how easily I can manage so as to send this power of electricity from place to place by choosing the materials which can conduct the power. Suppose I want to fire a portion of gunpowder, I can readily do it by this transferable power of electricity. I will take a Leyden jar, or any other arrangement which gives us this power, and arrange wires so that they may carry the power to the place I wish; and then placing a little gunpowder on the extremities of the wires, the moment I make the connexion by this discharging rod, I shall fire the gunpowder [the connexion was made and the gunpowder ignited]. And if I were to shew you a stool like this, and were to explain to you its construction, you could easily understand that we use glass legs because these are capable of preventing the electricity from going away to the earth. If, therefore, I were to stand on this stool and receive the electricity through this conductor I could give it to anything that I touched. [The Lecturer stood upon the insulating stool and placed himself in connection with the conductor of the machine.] Now I am electrified, I can feel my hair rising up as the paper tassel did just now. Let us see whether I can succeed in lighting gas by touching the jet with my finger. [The Lecturer brought his finger near a jet from which gas was issuing, when after one or two attempts the spark which came from his finger to the jet set fire to the gas.] You now see how it is that this power of electricity can be transferred from the matter in which it is generated, and conducted along wires and other bodies and thus be made to serve new purposes utterly unattainable by the powers we have spoken of on previous days; and you will not now be at a loss to bring this power of electricity into comparison with those which we have previously examined, and to-morrow we shall be able to go further into the consideration of these transferable powers.

Fig. 11.



(*The Sixth and last Lecture, on the* Correlation of the Physical Forces, *will be given in our next.*)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY,—*Jan.* 19, 1860—*concluded.*

Professor Brodie, *F.R.S. President, in the Chair.*

Mr. Frederick Field made a verbal communication respecting the double sulphides of copper and iron. He observed that, from many analyses of those compounds, the sulphur, copper, and iron, existed in certain definite proportions, the copper being always in the state of disulphide (Cu_2S) whilst the iron appeared to be in many different states of sulphuration. By washing, or by the addition of carbonates or oxides of copper, the percentage of that metal was necessarily increased, a proportionately larger number of atoms of disulphide being formed to the atoms of the sulphides of iron, until by continuing the process still further all the iron was

expelled, and a simple di-sulphide of copper remained. Thus a regulus containing 17·20 of copper, was found likewise to contain 52·68 per cent. iron, and 30·10 sulphur, and the formula of this compound may be expressed by the following numbers:

$$(Cu_2S)\ Fe_2S_3,\ FeS,\ 2Fe_2S.$$

or one of disulphide of copper in union with one of sesquisulphide, one of protosulphide, and two of di-sulphide of iron.

On roasting the above for some time, the compound of

Cu	36·12
Fe	56·78
S	27·08
	99·98

was obtained, agreeing with the formula

$$3(Cu_2S),\ Fe_2S_3,\ FeS,\ 2Fe_2S$$

and by further similar treatment:

	Cu	49·71
	Fe	25·34
	S	24·85
		99·90
and	Cu	61·34
	Fe	15·65
	S	25·00

agreeing respectively to

$$6(Cu_2S)\ Fe_2S_3,\ FeS,\ 2Fe_2S.$$

and

$$12\ (Cu_2S)\ Fe_2,\ FeS_2,\ 2Fe_2S.$$

Mr. Field also remarked how greatly the increase of copper in regulus reduced the iron in comparison with the sulphur, thus in the last analysis, the sulphur is less by two per cent. than in the preceding, and the iron is 10 per cent., so that in practice not much advantage is gained, as far as the expulsion of sulphur is concerned, by calcining regulus of a per centage of 60 to 70 than of 45 to 50.

The same gentleman briefly explained two different modes of reducing regulus to powder, employed in some establishments in South America. One, by a process patented sometime since by Mr. Napier, which consisted in adding nitrate of soda to the regulus in the furnace immediately after skimming, and by plunging the *pigs*, after tapping, in a tank of water — the regulus was reduced to an impalpable powder, by the disintegration, and a sulphide of sodium formed, which dissolved out small quantities of the sulphides of antimony and arsenic. The other method consisted in simply crushing and sifting the regulus. Both methods have their attendant advantages, but whereas in the latter method regulus of any per centage may be crushed, that compound, in Mr. Napier's process, must not contain more than 50, or at any rate 54 per cent. of copper, or disintegration will not take place.

The Chairman, after Mr. Field had concluded his paper, called the attention of the meeting to a cast of a nugget of gold, kindly shown by Mr. Tennant. It came from King-over Diggings, 120 miles from Melbourne. It was melted in August, 1858, and yielded gold to the value of 690*l.* 12*s.* 9*d.*

Dr. Longstaff mentioned with reference to gold that some years since upon visiting some gold regions, there was one circumstance which came before him to which he paid particular attention at the time, and which ended in a practical result of considerable advantage to miners. It was found that, in extracting the gold from quartz, the yield varied very considerably, and at times they were much disappointed in the quantity of gold yielded by quartz from the same locality,— in fact, at one time they got a considerable product, and another time they procured very little from another batch of the same ore. That induced him to examine the material which was left after extraction, and on testing the *tail* he found a considerable quantity of gold in it, which however on bringing it in contact with quicksilver refused to amalgamate. That led him to suspect that there might be a coating of unctuous matter on the gold which prevented the action of the mercury. He suggested therefore that they should mix with the crushed quartz a quantity of wood ashes, and by that means they succeeded in very considerably increasing the yield. He proposed the working over again of 50 or 60 tons of *tailing*, which was accordingly done, and they got very much larger quantities of gold from it than they did from the original ore. He thought that in all cases where wood ashes could be obtained without much difficulty it would be found advisable to add them from time to time in the mills. In the case just mentioned it was thought a most wonderful discovery, and was the means of causing some mills to be reworked at a profit which had before been obliged to stop.

Mr. Field stated that he had had some large pieces of so-called native zinc sent to him for analysis. They were almost entirely soluble in dilute sulphuric acid. On speaking to one of the workmen about them he was shown how this native zinc was formed. The miners worked up clay into a hollow lump and then poured melted zinc into it. This was afterwards rubbed over with earth, which gave it the appearance of silver stone. Travellers passing by the mines would readily purchase these specimens.

Mr. Phillips stated that wood ashes had been found to be of very great use in the barrel amalgamation process of extracting silver in Spain. It seemed to assist the process in some way or other — perhaps in the way suggested as to gold.

UNIVERSITY OF LONDON.

The Senate of this University has recently, in accordance with representations made to it by many of the most eminent men of science in the country, instituted the degrees of *Bachelor* and *Doctor of Science* (B. Sc. and D. Sc.). Candidates for the former degree, that of B. Sc., will be required to have passed the matriculation examination, and to pass two subsequent examinations: but Bachelors of Arts of this university, and undergraduates who shall have passed the first examination for the degree of Bachelor of Medicine of this university, will be admitted to the degree of Bachelor of Science on passing the second B. Sc. examination only.

The first B. Sc. examination is to take place once a year, and to commence on the third Monday in July. No candidate will be admitted to this examination within one academical year of the time of his passing the matriculation examination, nor unless he has transmitted to the registrar, at least a month before the commencement of the examination, a satisfactory certificate of good conduct.

The fee for the examination will be 5*l.*; and candidates will not be approved unless they show a competent knowledge of the fundamental principles of (1.) Mathematics; (2.) Mechanical and Natural Philosophy; (3.) Chemistry; (4.) Biology, including Botany and Vegetable Physiology, and Zoology and Animal Physiology.

Any candidate who has passed the first B. Sc. examination may be examined for honours.

The second B. Sc. examination will take place once a year, and will commence on the fourth Monday in October. No candidate will be admitted to it within one academical year of the time of his passing the first B. Sc. examination. The fee and the regulation with regard to the certificate of good conduct are the same as in the former case. The subjects of examination will be, Mechanical and Natural Philosophy, — Chemistry, Inorganic and Organic, Theoretical and Practical, — Animal Physiology, — Geology and Palæontology, — Logic, and Moral Philosophy.

Any candidate who has passed may be examined for honours.

The examination for the degree of Doctor of Science (D. Sc.) is to take place annually within the first fourteen days of June. No candidate will be admitted to this examination until after the expiration of two academical years from the time of his obtaining the degree of B. Sc. Candidates for this degree in any year must give notice of their intention to the registrar, and pay to him a fee of 10*l.* on or before the 1st of April.

The subjects embrace the usual branches of Physical, Biological, Geological, and Mental Science.

In following the course of study required as a preparation for these degrees, candidates are left to their own free choice both as to locality and as to instructors; and by the new charter recently granted to the university, candidates for the degrees in *Arts* enjoy the same liberty, so that these degrees also are now open to every one who can stand the test of the successive examinations to which candidates for them are subjected.

NOTICES OF BOOKS, PATENTS, &c.

The Radical Theory in Chemistry, by JOHN JOSEPH GRIFFIN, *F.C.S., Hon. Member of the Philosophical Society of Glasgow.* 1858. London: J. J. Griffin, Bunhill Row.
Chemical Recreation: a popular Manual of Experimental Chemistry. Same Author. Tenth Edition. 1860.

THERE are more than one kind of chemists. There are the real workers in the science, men who spend the best part of their lives in the laboratory, earnestly accumulating facts; men whose greatest happiness is the production of new substances; men who use the theories in vogue merely as means to an end, who have a certain amount of faith in them, but who do not care one iota whether oxygen has an atomic weight of eight or sixteen, or whether an atom of hydrogen occupies the same or twice the space of oxygen. Such men know that the quantities in chemistry are merely relative — that we have no means as yet of knowing the absolute truth as it exists in the mind of the Deity — and they are satisfied with receiving chemical theories more as systems of classification than as expressions of ultimate fact. There are others who consider these points as vital, who will descant with great ingenuity, but less temper, not only upon the impossibility of more than one system of chemical notation being correct, but also upon the utter stupidity of all who do receive the one system with implicit faith. These second class of chemists do not, as a general rule, make researches, — they read the researches of others, and, while reading, slowly but solemnly inflate, the principle of expansion being a sublime consciousness of the inferiority of the worker to the theorizer. Sir Humphry Davy has said: "When I consider the variety of theories which may be formed on the slender foundation of one or two facts, I am convinced that that it is the business of the true philosopher to avoid them altogether. It is more laborious to accumulate facts than to reason concerning them; but one good experiment is of more value than the ingenuity of a brain like Newton's." There are facts — stern, unbending and uncompromising facts — which no theories now known will either reconcile or explain. There is not one theory which can explain the annexed equation.

$$C_4H_5Na + 2CO_2 = C_6H_5NaO_4.$$

It is a mere case of simple addition, and yet if any chemist had predicted such a synthesis he would have been pronounced insane. If chemists would always be honest enough to admit when the facts are first discovered and the theories drawn from them afterwards, how much better we should esteem them. The general rule is, as soon as a remarkable and probably unexpected fact comes to light, for the discoverer to write his paper as if he had foreseen the new reaction. If chemists did but know how internal evidence generally betrays their mental process, they would see the true policy of being strictly candid. We disclaim allusion to any one person or reaction, we allude to working chemists generally, here and abroad; and it is evidently impossible, for obvious reasons, that the remark we have made can apply to the author now mentioned.

Mr. J. J. Griffin has been for many years before the public both as an author and a commercial man. Chemists are not generally aware of the debt of gratitude they owe him for the introduction of foreign apparatus and appliances into this country. At a time when good chemicals and instruments were to the last degree difficult to procure, Mr. Griffin, at great pecuniary risk, brought from various parts of the continent to this country all that was likely to assist the working chemist in his labours. He also found time to make an excellent translation of Rose's *Treatise on Analysis*; he even produced a laborious work on Crystallography, and two other books, namely, the *Romance of Chemistry* and the *Chemical Recreations*. All these works display talent and powers of application of a superior kind. A more charming book for young students of chemistry than the first few editions of the *Chemical Recreations* was never penned. The *Romance of Chemistry*, although cleverly written, was deformed, like all his theoretical writings, by an unbecoming way of speaking of all who did not think in the same manner as himself. Even Berzelius, the profound, the laborious Berzelius, whose memory all chemists who know the history of their science gratefully revere, was treated with a flippant ridicule which we should be sorry to apply even to the theories of our author.

The Radical Theory in Chemistry is a laboriously thoughtful book; it is not our intention to criticise the theories in it minutely in this place, because it would be utterly impossible in the space which can be spared to a review. It is the less necessary, because, in all probability, all that is original in them will before long be noticed in Dr. Odling's work. We may however mention that the author appears to consider ridicule as powerful an engine of conversion as he did a quarter of a century ago. At page 201 he says: "I shall, for the sake of brevity, only quote such of these names," alluding to the organic bases, "as serve either to identify the compounds, or to exhibit some of the vagaries of chemists, or to illustrate important or disputed doctrines." Mr. Griffin is ironical in his remarks on Dr. Hofmann's systematic but necessarily sesquipedalian nomenclature for the bases discovered by him. He does not appear to be aware that Dr. Hofmann never intended these names to remain in science, but merely used them as a means of description. It is amusing, therefore, to find that Mr. Griffin seriously proposes to chemists to call dolomite, "bis magnen carbite tris calcen carbite," and to use such delightful terms as "zincen carbite cum zincabon hydronose" (p. 185).

Mr. Griffin is angry with Dumas for being sarcastic upon Longchamp, but he nevertheless hurls the following avalanche of irony upon M. Stadeler, and his base acetonine:—"I do not believe in the existence of this assumed new base. Acetone itself contains acetyl and methyl, see p. 77. Acetonia is comprised of an ammon and an amid, including the same radicals; and the platinum salt and the binoxalate can be explained (see Nos. 205, 206) without resorting to the expedient of creating a hypothetical 'new base' to meet the special circumstances, an expedient to which organic chemists resort with a too ready facility. When compound salts can be clearly explained by means of well-known existing radicals, what is the use of making imaginary bases? In the present case, three atoms of methyl, three atoms of acetyl, and two atoms of azote are rolled up into a giant new base, and called acetonia. This method of practising synthesis is becoming really alarming" (p. 216). After this we may consider M. Stadeler and his unhappy base as having ceased to exist.

Mr. Griffin generally writes in a tone indicative of extreme mental depression, but at p. 292 he recklessly plunges into the funny.

"The name melaniline was adopted in consequence of a relationship or an analogy which Dr. Hofmann supposed to exist between this body and the compound which is usually called melamine. According to my way of formulating these two compounds, they are as follows:—

Melamine = ZH_2, Cyl = Amida cyanyla.

Melaniline = { ZH, C_6H_5; Cy } = Phenylac cyana cnm
{ ZH, C_6H_5; H } = phenyl hydra.

The relationship which exists between these two compounds is certainly very distant; a sort of Scotch-cousinship a great many times removed."

We wonder if Dr. Hofmann has ever read the work before us, and, if he has, how he felt on seeing the havoc which Mr. Griffin makes with his formulæ.

Every one remembers poor Laurent's exclamation, — "What have I to do with your copulæ, your radicals, and your castles of cards?" Mr. Griffin appears to endeavour to feebly imitate his style in many places, among others at p. 296, where, alluding again to his old enemy melaniline, he says: —

"What have we to do with mellon or aniline mellon, or with C_6H_4, or $C_{12}H_4$, or $C_{12}H_4N_4$? The process and its interpretation are extremely simple, and require none of these far-fetched luminaries to enlighten them."

Again, on the next page, we have —

"These three formulæ exhibit the usual excellencies of Gerhardt's 'type ammonia,' and make simple things complex with remarkable facility."

When we know that hundreds of chemists have found the types of the late illustrious chemist M. Gerhardt of the greatest assistance to them in their studies and researches, and that they have not as yet found the "Phenylam phenylac cyanen" of Mr. Griffin help them (at least except so far as it has contributed to give an air of playfulness to an otherwise grave subject), we cannot escape the conclusion that it would be better to avoid such attempts at sarcasm and fine writing.

At p. 308, chemists (by the way, it is evident from the perpetual abuse Mr. Griffin lavishes upon "chemists" that he does not consider himself to belong to the fraternity) are said to be in a "muddle" as regards the platinum bases. Undoubtedly there are great difficulties in the way of a clear understanding of the matter, and when we remember that Mr. Griffin repeats the classic word "muddle" no less than six times on p. 308, we *do* think he was bound to throw a new light upon it. He does not, however appear to agree with us upon this point.

At p. 313 Mr. Griffin, finding his subject a little too heavy even for him, plunges headlong into *The Renowned History of the Seven Champions of Christendom*. He then tells chemists to "unmuzzle their wisdom" (p. 314). We here anxiously ask if Mr. Griffin has been unmuzzled; because, if so, it is high time for "orthodox chemists" to look out.

We refrain, as an unprofitable task, from quoting any more of Mr. Griffin's sarcasms, or playful remarks; it is true that in one place he quotes Joe Miller, and that in another Mr. Woodin and Miss P. Horton are dragged in as illustrations; but as it appears to make him happy and does no one any harm, it may be passed over without further comment.

There can be no doubt that Mr. Griffin has most laboriously studied his subject, and that in many cases there is reason in his arguments. It is true that he is not always careful to let us know exactly the amount of novelty in his views, that he does not always tells us whose ideas he is enunciating, and therefore the student may sometimes give him a little more praise for originality than he deserves; but it may in fairness be set off against the numerous instances where arguments which are strictly his own will pass without obtaining a proper meed of appreciation.

There is one important point upon which our author insists very strongly, and where he has a certain amount of common sense on his side. As usual, however, he deforms his argument by a melancholy attempt at sarcastic writing. We allude to the use of hydrogen as a standard for the specific gravities of gases and vapours. At p. 140 of his *Chemical Recreations*, he says: —

"One of the marvels of modern chemistry is the persistence of its professors in the practice of comparing the specific gravities of gases with that of common air taken as unity. To be consistent they should adopt the additional absurdity of taking the composition of common air as the standard of the atomic weight. Just look at these two examples of specific gravities! the atomic weight of mercaptan is 62, and its specific gravity is 31; the atomic weight of alcohol is 46, and its specific gravity is 23; these numbers are too simple to have the proper look of philosophical profundity, so the authorities of our science fix the specific gravity of mercaptan at 2·15822, and of alcohol at 1·60049— beautiful numbers! which contain the quantity of Egyptian darkness necessary to render them grand and mysterious, and which confer upon the scientific world the remarkable advantages that always flow from the statement of simple facts in terms which no memory can retain."

Mr. Griffin does not appear to be aware that the adoption of hydrogen as the standard for specific gravities of gases and vapours is by no means a new idea. Faraday many years ago referred the densities of his oil gas hydrocarbons to hydrogen. Turner also published tables where the densities were referred to hydrogen as unity. These are only two examples out of many. Besides, every chemist knows quite well that it is only necessary to perform a sum in simple division, to convert the density as compared with air into the density as compared with hydrogen. Can it be possible that Mr. Griffin does not know the reason why chemists always publish their densities as compared with air! Does he not know that chemists, for obvious reasons, always weigh their balloons full of air before filling them with the gas or vapour to be compared with it? Chemists, therefore, are simply guilty of the crime of stating their results as they get them, and leaving ingenious theorists like Mr. Griffin to perform their problems in simple division for themselves.

To sum up, the new edition of *Chemical Recreations* is a handsome volume, illustrated with 537 cuts. It is useful as containing excellent views of the best modern apparatus. Descriptions of the facts of the science are almost always given in a clear comprehensive style. Mr. Griffin's own admirable blast gas furnace is clearly described in it, as well as the furnaces of Deville and others. A vast number of appliances are to be found in this work, which have never before appeared in a chemical treatise; and the absence (in most cases) of the insulting sarcasms which appear in almost every chapter of the *Radical Theory*, makes it a pleasant and readable book, and one which may with advantage be placed in the hands of students.

Improvements in Vulcanising and Colouring Caoutchouc, and in the preparation of Caoutchouc Paints and Colours. R. Archibald Brooman. 1859. A communication.

The process for vulcanising caoutchouc consists in passing it three or four times, at intervals of a day, through a bath prepared of benzine, having in solution 5 per cent. of red or black sulphuret of mercury, or 2 per cent. of bromide of sulphur. It is next immersed in a chloride of lime bath, containing about four pounds of chloride of lime to eight quarts of water, and allowed to remain there about twelve hours. It is then dried by exposing it for about eight days to a temperature of 60° or 70° Fahr.

In order to colour caoutchouc a portion is first dissolved in benzine, turpentine, olive oil or other solvent, and to produce the colours the following ingredients are used. For white, zinc white; for blue, ultramarine; for red, vermillion; for light brown, orpiment; for chocolate, a mixture of ultramarine and vermilion; for green, a mixture of ultramarine and chrome yellow.

Before other colours are applied to sheets of india-rubber it must be covered with two coats of zinc white, applied at intervals of about twenty-four hours, and upon this foundation the desired colours may be produced by the application of from three to five coats of the colour required. After the desired number of coats have been applied, the sheets in their extended state must be kept for six or eight days at a temperature of from 60° to 70° Fahr.

The inventor also makes elastic paints by mixing with ordinary paints India-rubber or gutta-percha dissolved in benzine, turpentine, olive, poppy, or linseed oils.

The caoutchouc paints or colours may be used for paintings or frescoes, for decorative purposes generally, for preserving buildings, and for protecting iron and other metals from oxidation.

CORRESPONDENCE.

The Atomic Theory.

To the Editor of the CHEMICAL NEWS.

SIR,—I beg leave to lay before you a proof of the existence of *indivisible atoms* that has lately occurred to me.

Let g represent the force of gravity upon the surface of a sphere whose radius is r, then $g \propto r^{-2}$ expresses the fact that gravity varies inversely as the square of the distance. Again, $g \propto r^{3}$ expresses the fact that gravity varies as the mass.

Hence we see that g varies conjointly as r^{-2} and r^{3}, therefore, $g \propto r^{-2} \times r^{3}$ and finally, $g \propto r$. So that we may say that the attraction between spheres vary as their radii. Now supposing that matter were *infinitely* divisible, we should have $r = 0$. But $g \propto r$, consequently the particles of which matter consists would have no attraction one for another, which is absurd, *therefore there are indivisible atoms.*—*J. S. Barrett.*

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

A New Reducing Agent. — The proto-sulphate of iron alone does not reduce either the bichloride of platinum or bichloride of mercury. M. Hempel [1] has remarked that the reduction is promptly effected when an alkali is added to the mixture. On treating bichloride of mercury by a mixture of protosulphate of iron and an alkali, and then adding sulphuric acid, protochloride of mercury is obtained. The filtered liquid is quite free from the metal. The nitrate and sulphate of mercury behave in the same way if care be taken to add previously a little chloride of sodium.

The author makes use of this reaction for the estimation of mercury. If the liquid contains at the same time gold and silver, these metals are precipitated beforehand, the one by means of proto-sulphate of iron, the other by chloride of sodium.

Preparation of Platinum Black. — M. Hempel [2] obtains platinum black by adding to bichloride of platinum, first protosulphate of iron, then caustic soda, and afterwards hydrochloric acid. The black powder which remains is well washed with acidulated water, and then dried.

The formation of metallic platinum is based on the reaction effected by the protoxide of iron.

Solubility of Tartrate of Baryta. — H. H. Vogel Reischauer [3] have observed that tartrate of baryta exists in two different states,—the amorphous and the crystalline; and that in the amorphous state the salt only requires 833 parts of water for solution, while in the crystalline state it requires 1300 parts. This difference in the solubility is shown by a very simple experiment. A precipitate of the amorphous tartrate being obtained, just sufficient water is added to redissolve it; in a few seconds the clear liquid becomes cloudy in consequence of the formation of crystalline tartrate.

Action of Chlorine on the Carbonates of Lime and Baryta. — M. Merz [4] passed chlorine gas at the ordinary temperature into water holding in suspension recently precipitated carbonates of baryta and lime. The chlorine was rapidly absorbed. When the operation was terminated the resulting solution was evaporated, and the residue was found to be composed of a mixture of the chlorates of baryta and lime as well as the chlorides of barium and calcium.

II. ORGANIC CHEMISTRY.

New Derivatives from Quercitrine. — Rigaud had found that quercitrine belonged to the glucosides, and might be decomposed into a carbohydrate and another body which he called *quercetine*. Hlasiwetz [5] has now found that quercetine itself contains the elements of a sugar, the *phloroglucine*, which the same chemist has observed among the products of the decomposition of phloretine. Quercetine is boiled with concentrated solution of potash, and is then diluted with water. The solution is now neutralised with hydrochloric acid, and after some time it deposits a flocculent matter formed of a mixture of quercetine, and an unstable body which appears to be a derivative of this principle. The liquid filtered from the flocculent matter is evaporated to dryness and then extracted with alcohol: the alcohol is then driven off and the residue dissolved in water. The solution now contains two substances separable by means of acetate of lead, which will not precipitate the phloroglucine. To isolate this the lead is removed from the filtered liquid by sulphuretted hydrogen, and the solution filtered from the sulphide of lead is quickly evaporated. Crystals of phloroglucine are deposited, which may be purified by animal charcoal.

The body precipitated by acetate of lead is a weak acid which offers some resemblance to gallic acid. The author gives it the name of quercetic acid. To obtain it the lead precipitate is decomposed by sulphuretted hydrogen, and the liquid filtered from the sulphide is carefully evaporated, on which brown crystals are formed which may be purified by animal charcoal.

When pure the crystals are silky needles slightly soluble in cold, but freely soluble in hot, water, in alcohol, and in ether. The aqueous solution becomes coloured in the air. The crystals are efflorescent and may be partially volatilised. Their solution reduces the salts of silver; perchloride of iron colours it black. When a few drops of an alkaline solution are added to a very dilute solution of quercetic acid it first turns yellow, and when agitated in the air becomes a beautiful red. The same acid colours strong sulphuric acid red, and water then separates red flakes which in contact with alkalies become of a magnificent purple.

In a crystalline state quercetic acid has the composition $C_{24}H_{12}O, 6 + 7HO$.

Ellagic acid, which a good deal resembles this acid, differs only by C_6H_6.

III. CHEMICAL ANALYSIS.

The Determination of Free and Combined Carbonic Acid and Sulphuretted Hydrogen in Mineral Waters. — The process suggested by M. Gaultier de Claubry [6] for determining the amount of free carbonic acid, apart from that which is combined with lime, magnesia, and protoxide of iron, in the form of soluble bicarbonates, consists in passing through the water either a current of atmospheric air which has been freed from carbonic acid, or a current of hydrogen. The free carbonic acid only is removed, and the bicarbonates remain in solution. When the water contains bicarbonate of iron hydrogen must be used, and the current of gas must be stopped the moment the liquid becomes cloudy, indicating the commencement of decomposition. The air or hydrogen, after passing through the water, is dried, and then passed through a weighed potash bulb.

Sulphuretted hydrogen in solution is equally well removed by a current of hydrogen which may be passed into a proper absorbing apparatus.

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1 *Annalen der Chemie und Pharmacie*, v. cvii. p. 97.
2 *Ibid.*
3 *Neues Repertorium für Pharmacie*, v. viii.
4 *Polytechnische Journ.* cliii. p. 358.
5 *Annal. der Chemie und Pharmacie*, v. cxii. p. 97.
6 *Comptes-Rendus*, v. xlviii. p. 1049.

Chemical Composition of Meteorites.—Reichenbach[7] has collected together the analyses of a great number of meteorites; and taking into account only those which appear to him to be exact, and which relate to meteorites the fall of which has been well authenticated, he has found that the mean composition of these bodies in round numbers is as follows:—

Silica	40·00	Chromium	0·50
Magnesia	20·00	Manganese	0·33
Iron	25·00	Soda	0·33
Alumina	2·00	Other Elements	1·34
Sulphur	2·00	Oxygen	5·50
Lime	1·50		
Nickel	1·50		100·00

SCIENTIFIC NOTES AND QUERIES.

Determination of the amount of Alcohol in Wines or other alcoholic Fluids.—Sir,—The method given in the Chemical News (No. 3, p. 36) for determining the amount of alcohol in wines is not correct. In the first place there is an error in the working of the example; ·9873 is not the difference between 1·0080 and 0·9953; the difference is ·0127. But even were the rule followed it would give a false result, as will appear from the following:—The wine may be regarded as a mixture of two fluids A and B; A being a solution of sugar, tartar, &c., B a solution of alcohol in water. Let v_1, s_1 be the volume and specific gravity of A; v_2, s_2 the volume and specific gravity of B; then the specific gravity w_1 of the wine is $w_1 = \frac{v_1 s_1 + v_2 s_2}{v_1 + v_2}$. Now when B has been evaporated off and replaced by an equal volume v_2 of water of specific gravity = 1 the specific gravity w_2 of the mixture is $w_2 = \frac{v_1 s_1 + v_2}{v_1 + v_2}$. Taking the difference Δ, we get $\Delta = w_2 - w_1 = \frac{v_2(1 - s_2)}{v_1 + v_2}$. If *half* the wine is evaporated $v_1 = v_2$ ∴ in this case $\Delta = \frac{1 - s_2}{2}$ ∴ $s_2 = 1 - 2\Delta$. Hence in the example given we have $s_2 = 0{\cdot}9746$.—*E. G.*

Purification of Water by the use of Oxide of Manganese.—Sir,—Mr. Spencer appears to be rather *sharp* upon others respecting what he calls "his discovery." His own remark in your 4th number upon Professor Kuhlmann's paper, also applies to *himself*, viz.: "It is impossible for me to know what *private laboratory notes* do exist" now-a-day. In my opinion Mr. S. *assumes* rather too much for himself in regard to this question, and I doubt if his patent will *hold good*, and most certainly not as regards the use of *manganese*, which book after book *for years back* alludes to for purifying and sweetening water, and it is now several years since that its *decolorising* properties were brought to my notice. The law of patents requires *reform*. Some years ago I had to restrain a certain Liverpool chemist for *infringement* of a patent for purifying water which I had taken out a *dozen years* before and had sold to a French engineer; so that if this chemist's patent agent had done his duty, he would have prevented him from throwing away his money upon a *supposed priority* of invention, and running the risk of an "action of law." Mr. S. has entirely *misunderstood* that part of my letter which spoke of the admixture of chloride of lime with manganese. It was *not* intended to be applied to water for *household purposes*, but as a deodorant and disinfectant of liquid sewage, &c.—*John Horsley, F.C.S.*

[We do not think that a continuance of this discussion will either interest or instruct our readers.—Ed.]

The Metallic-iron Water-purifying Patent.—Sir,—In a short note which appeared in your third number, I remarked that the principle of the "purification of water by means of *metallic* iron" had been patented, but did not name the patentee. As the omission however has been taken advantage of, I think it right to state that Dr. Medlock is that gentleman, whose interesting researches were published in the *Philosophical Magazine* of September 1857 and January 1858.—*Thomas Salter, F.C.S.*

Stannate of Soda.—Sir,—Can any of your correspondents be good enough to furnish me with the practical process involved in the manufacture of *commercial* "*Stannate of Soda*," and oblige *A Subscriber.*

[7] *Poggendorf, Ann. der Physik und Chemie*, v. cvii. p. 553.

LABORATORY MEMORANDA.

Estimation of Mixtures of Acids or Alkalies in Solution.—The following method of analysing a mixture of acids or alkalies may be useful to some of your readers. The method will be explained most shortly by an example. Suppose then it were required to analyse a mixture of tartaric and citric acids; suppose w grains of the mixture contains x grains of tartaric and y grains of citric acid. Saturate w grains of the mixture with potass, and let w_1 = the number of grains of potass used. Again, saturate another w grains of the mixture with soda, and let w_2 = the number of grains of soda used. We then get two equations each containing the unknown quantities x and y, which may ∴ be found. The result is checked by saturating a third quantity of w grains with some other alkali; calling w the quantity of it used, we get another determination of x and y. If there were three acids in the mixture we should require three equations in order to determine the quantities of each. In general we require as many independent equations between the unknown quantities as there are unknown quantities.

The quantities of alkalies used for saturation are known at once, if we saturate with solutions of known strength, and deliver them from an alkalimeter.—*E. G.*

MISCELLANEOUS.

Effects of Arsenical Paper.—There is an exceedingly beautiful paper of an apple-green colour, which is often selected for the coolness and cheerfulness of its appearance. The writer was himself once deluded by the seductive appearance of a paper of this description, and had his library furnished with it. Strange to say, a violent cold seemed to seize every one, even in the midst of summer, who stopped long in this apartment, especially if they came much in contact with the walls. On questioning the paper-hanger, the mystery was speedily explained. "I never hang that kind of paper," he said "without getting a bad sore throat and a running of the eyes—all the trade knows it is good for a cold to have any dealings with it." The cheerful green of the paper is nothing less deadly than the aceto-arsenite of copper: an irritant poison of the first class. The flock of this paper contains a large quantity of pigment, in the form of dust, which is of course liable to be detached from the walls on very slight occasions. It has been erroneously supposed that the metal must be volatilised by heat ere it can be separated from the paper; but the action of detachment is mechanical and not chemical; the poisonous dust either falls or is brushed off the walls, and becomes mixed with the ordinary dust of the room; the lifting of a book, or the displacement of a pile of papers, proves sufficient to set these particles in motion, and to bring them into contact with the mucous membranes of the eyes, nose, and throat; hence the violent irritation produced, which simulates so closely the effects of a bad cold in the head.—*Edinburgh Review.*

Alum Lozenges.—A Venetian physician, Dr. Argenti, proposes to employ alum lozenges instead of alum gargles for sore throats, loss of voice, &c. He directs them to be prepared of alum, gum arabic, sugar and laurel water in such proportions that a lozenge of six grains may contain one grain of alum.

ANSWERS TO CORRESPONDENTS.

Mr. C.—The proportions vary according to the price and the consciences of the manufacturers. No two houses use the same proportion. No analyses of the kind have been published that we remember.

C. D. S.—We will comply with the wish of our correspondent soon.

W. H. (Tillydesk)—Next week.

W. M. (Manchester).—1. Sulphide of iron, which may be obtained at most chemists, would no doubt answer the purpose, if pyrites cannot be procured. 2. The simplest way is to burn it, and see the amount of ash left; ivory black leaves a great deal and charcoal scarcely any ash.

A. B. should consult an elementary work on chemistry.

X. Z.—The process does not answer on a large scale.

M. (Newcastle).—Either will answer.

G. C.—Impossible to advise.

A Subscriber (Leeds)—*Yokels*—*J. C. B.*—*De Monti*—received. Answers next week.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

VOL. I. No. 10. — February 11, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chemical Polarisation of Neutral Oxygen which takes place with the slow combustion of Phosphorus, by C. F. SCHÖNBEIN.[1]

THE author first describes the behaviour of a mixture of aqueous phosphorous acid and peroxide of hydrogen. This mixture has the following reactions: —

1. A dilute solution of chromic acid containing only one per cent. of the acid, is first coloured blue by the mixture; but ordinary oxygen is soon developed, and the solution becomes permanently green in consequence of the formation of a salt of chrome oxide. Diluted phosphorous acid will not alone reduce the free chromic acid, because from a mixture of two acid solutions no oxygen can be set free.

2. The mixture instantaneously decolorises a solution of permanganic acid or permanganate of potash with the rapid development of ordinary oxygen and the formation of a salt of manganous oxide. It is true that pure diluted phosphorous acid will also reduce permanganic acid to manganous oxide, but slowly, and naturally without setting free oxygen gas.

3. With peroxide of lead the mixture developes ordinary oxygen in the formation of a salt of protoxide of lead.

4. The mixture when added to water will not by itself colour blue a dilute solution of iodide of potassium and starch (the concentrated mixture will do so); but on the addition of a few drops of a dilute solution of sulphate of iron the starch mixture is instantaneously coloured blue.

5. At the ordinary temperature the mixture will slowly decolorise a moderately strong solution of indigo; but on adding a few drops of sulphate of iron solution it is instantly decolorised.

6. The mixture may be kept at a temperature of 212° Fahr. for some hours without losing the power of turning the solution of iodide of potassium and starch blue, with the co-operation of the dilute sulphate of iron solution.

8. Platinum black placed in contact with the mixture occasions no perceptible development of oxygen gas; but by continued agitation of the metallic powder with the liquid, the power of turning the iodide of potassium paste blue is completely lost.

8. The mixture may remain for days in contact with finely divided phosphorus without losing the property of colouring the iodide of potassium paste blue; but by standing together a longer time the power is lost.

Let us now see how the acid liquid behaves which is obtained by the action of phosphorus on moist air, or oxygen attenuated by means of the air pump, and in which chemists until now have found nothing but phosphorus and a little phosphoric acid.

If some pieces of phosphorus an inch long, with a clean surface, are placed in an open porcelain dish with sufficient water to about half cover them, and are allowed to remain for 18 or 24 hours at a temperature of from 60° to 68° Fahr., the acid liquid which is poured away from the phosphorus will show the following reactions:

1. On mixing the liquid with dilute chromic acid solution, it is at first coloured somewhat blue; but if the phosphorus has been exposed to the action of the atmospheric oxygen a sufficient time, and provided too much chromic acid has not been used, the solution becomes of a permanent green colour, owing to the formation of a salt of chrome oxide, as is evident from the circumstance that chrome oxide may be precipitated from the green solution.

2. A solution of permanganic acid or permanganate of potash is instantaneously decolorised by the liquid, by the development of ordinary oxygen and the formation of a salt of manganous oxide.

3. Placed in contact with peroxide of lead the liquid sets free ordinary oxygen from the formation of a salt of lead oxide.

4. The strong liquid diluted with water loses the power of turning the iodide of potassium and starch solution blue by itself, (the concentrated solution will do this,) but on the addition of a few drops of a solution of sulphate of iron the mixture instantly acquires the deepest blue colour.

5. If coloured blue with indigo tincture, the mixture is slowly decolorised at the ordinary temperature, but it is changed instantly on the addition of a dilute solution of sulphate of iron.

6. The mixture may be kept boiling for some hours (being brought up to its original bulk by occasional additions of water) without losing the power of changing the iodide of potassium and starch solution blue with the help of the sulphate of iron.

7. Platinum black introduced into the liquid occasions no sensible evolution of oxygen gas, but if the two be shaken together for some time the liquid loses the power of bluing the iodide of potassium and starch.

8. The liquid may stand in contact with finely divided phosphorus for days, without losing the property of turning the iodide of potassium and starch blue on the addition of sulphate of iron solution; but by remaining together longer the power is lost.

When we compare the behaviour of this liquid with that of the artificially prepared mixture of phosphorous acid and peroxide of hydrogen, we see between the two the most perfect accordance, and the resemblance warrants us in drawing the conclusion that the liquid contains HO_2; and that by the slow combustion of phosphorus in atmospheric air, or attenuated oxygen peroxide of hydrogen (as well as phosphoric and phosphorous acids) is formed; and, indeed, under favourable circumstances in considerable quantity.

It is easy to obtain a fluid which mixed with a solution of permanganate of potash gives, proportionately, at least, a large quantity of oxygen. If we place six pieces.

[1] *Journal für Praktische Chemie*, Bd. lxxviii. S. 63. *Chemisch Central Blatt*. Jan. 18, 1860.

an inch long, of tolerably thick phosphorus in a correspondingly large open porcelain dish, and cover half the circumference of phosphorus with water, and leave it exposed to the action of atmospheric air for about twenty hours at a temperature of 64° F., we shall obtain a liquid 10 cubic centimetres of which mixed in a graduated tube with a solution of permanganate of potash will develope 12 cubic centimetres of ordinary oxygen, indicating the presence of a considerable quantity of peroxide of hydrogen. Under favourable circumstances the author has obtained liquids which were still more strongly charged with HO_2.

It may certainly appear remarkable, that peroxide of hydrogen can exist in the presence of phosphorous acid which is considered easily oxidisable, and which is so ready to part with some of its oxygen to a number of oxidisable substances: it seems strange that even phosphorus can remain in contact with HO_2 without immediately reducing the same to water. But we are already acquainted with many instances of a like kind, as, for example, ozonised oil of turpentine and the similarly circumstanced ether, in which mixtures as well, active oxygen exists in contact with otherwise easily oxidisable matters.

So long as no ozonized oxygen (−O) appears, not the least trace of peroxide of hydrogen (HO+[+O]) can be discovered in the water which touches the phosphorus exposed to the action of atmospheric air, ; but as soon as ozonisation has taken place HO_2 is discoverable in the water. The simultaneous appearance of (−O) and HO+(+O) may be easily demonstrated in the following way. We place a few grammes of phosphorus with a clean surface, divided into several pieces, in a beaker with only sufficient water to partly cover the phosphorus. If the temperature reaches 64° or 68° F. ozonised oxygen soon appears as will be shown by placing a piece of paper moistened with iodide of potassium and starch in the neighbourhood of the phosphorus. If we now give the glass a rotatory motion so that the liquid may cover the phosphorus and then run off again, and continue the motion for only a few minutes, the water when poured off will be found to contain so much peroxide of hydrogen that its presence may be demonstrated by means of the iodide of potassium and starch and a few drops of the iron solution.

Such a simultaneous appearance of ozonised oxygen in the air above the phosphorus, and HO_2 in the water which touches the phosphorus seems the more extraordinary as the author's latest experiments show that −O and HO+(+O) are by shaking together converted into ordinary oxygen.

However long ozonised or ordinary oxygen was treated with water, no trace of peroxide of hydrogen was produced, which negative proof may justify the conclusion that the HO_2 formed by the slow combustion of phosphorus is produced neither from the ozonised nor the ordinary oxygen—a fact already made probable by the single circumstance that the active oxygen in the peroxide of hydrogen is in the (+O) condition, while that in the ozonised oxygen =(−O) and ordinary oxygen =O.

As HO+(+O) is not formed from HO and (−O) nor from O, and as it is a fact that HO_2 is only produced when ozonised oxygen appears, the question arises — in what causal connection does this simultaneous appearance of positive and negative active oxygen stand.

With regard to (−O) and (+O) which appear with the slow combustion of phosphorus, (−O) in a free state and (+O) in combination with water: it is certain that both are formed from ordinary O, which fact must lead to the conclusion that by contact with phosphorus the inert or neutral oxygen is split up, polarised or decomposed (*differencirt*), into two oppositely active conditions, or however otherwise we may describe this remarkable phenomenon.

As water is combinable with positive-active oxygen, it accordingly absorbs it to form peroxide of hydrogen, whilst part of the negative-active oxygen appearing at the same time escapes, on account of its gaseous nature, into the atmosphere above the phosphorus, the greater part combining to form phosphorous acid, which for the above reason, like phosphorus itself, can remain in contact with peroxide of hydrogen without abstracting its active oxygen. It is possible and even probable that part of the (+O) and (−O) produced by the polarising influence of phosphorus are immediately reconverted into O or ordinary oxygen.

From the preceding communication it seems that the changes produced by the slow combustion of phosphorus are less simple, but more interesting than was formerly thought, and the author is convinced that in this instance a chemical fundamental phenomenon lies before us, which when it shall have become rightly and perfectly understood, cannot fail to lead to the enrichment of theoretical chemistry.

Naturally we are not yet in a position to answer the first questions which arise; on what ground the (+O) and (−O) conditions of oxygen rest, and how phosphorus polarises chemically the neutral oxygen. The single thing in the interest of science that we can do at present is to demonstrate that this chemical polarisation effected by phosphorus is not an isolated instance but a common fact.

On the Carbonates of Alumina, Sesquioxide of Chromium, and Iron, by James Barratt, *Student in the Liverpool College of Chemistry.*

Having seen a notice of a recent paper by Dr. Wallace in the *Chemical Gazette* for 1858, vol. xvi. p. 411, I was induced by Dr. Muspratt to repeat some experiments made under his inspection some years ago, upon the carbonate of alumina, as also those of Dr. Wallace on this and the other carbonates above referred to.

Carbonate of Alumina. — Dr. Wallace prepared the alumina salt by precipitating a solution of chloride of aluminium by one of carbonate of soda, both being highly dilute. This precipitate, after being well washed on a filter, was levigated with water, then re-filtered, and subjected to prolonged washing; finally it was dried over sulphuric acid till no further loss of weight was experienced. On analysis, the desiccated mass yielded the formula:

$$3Al_2O_3.2CO_2 + 9HO. \text{ or, } 2(Al_2O_3.CO_2 + 3HO) + Al_2O_3.3HO.$$

The experiment of Mr. Joseph Danson above referred to, afforded the annexed composition, $3Al_2O_3.2CO_2 + 16HO$; Langlois obtained $8Al_2O_3.3CO_2 + 40HO$. Whilst, according to Saussure, the compound contains *no carbonic acid whatever*. The above statements are certainly most conflicting. I prepared the alumina campound precisely in the same manner as prescribed by Dr. Wallace. After washing it for two days, it was dried and analysed: the carbonic acid amounted to *three per cent.* It was then triturated in a mortar with water, thrown upon a filter, edulcorated repeatedly with water, and redried as before over sulphuric acid. On analysis the annexed results were obtained, corresponding with the simple hydrate of alumina.

	Atomic Weight.	Theory.	Found.
1 equivalent of alumina .	51	65·384	65·030
3 „ water .	27	34·616	34·970
Carbonic acid . .	-	-	none
	78	100·000	100·000

From the above it is evident that when an alumina salt is precipitated by an alkaline carbonate, there is no carbonate of alumina formed. The three per cent. of carbonic acid found in the first instance was in all probability due to the retention of some of the precipitant (carbonate of soda) by the hydrated alumina.

Carbonate of Chromic Oxide.—This compound was prepared by acting upon chloride of chromium in the same way as stated in regard to the preceding salt. It was a greenish powder, which yielded the formula undermentioned:

To Dr. Wallace . . . $Cr_2O_3.CO_2 + 4HO$
„ Berzelius . . . $4Cr_2O_3.CO_2 + 3HO$
„ Langlois . . . $2Cr_2O_3.CO_2 + 6HO$
„ Meisner . . . $10Cr_2O_3.7CO_2 + 8HO$
„ Lefort . . . . $Cr_2O_3.CO_2 + 4HO$.

Here again we see various statements, evidently owing to the different stages of washing at which the compound had been subjected when taken for analysis. Subjoined are the results I obtained with the above salt.

	Atomic Weight.	Theory.	Found.		
			1.	2.	3.
1 equivalent of sesquioxide of chromium . .	77	57·030	57·594	56·956	57·231
1 equiv. of carbonic acid . .	22	16·300	16·000	15·231	15·357
4 equiv. of water	36	26·670	26·046	27·813	27·422
	135	100·000	100·000	100·000	100·000

Formula $Cr_2O_3.CO_2 + 4HO$.

Carbonate of Ferric Oxide.—This compound was prepared by precipitating a dilute solution of sesquichloride of iron with one of carbonate of soda, and after thorough washing, dried in the air at 70° to 75°. It yielded to Dr. Wallace the formula:

$3Fe_2O_3.CO_2 + 16HO$ or $Fe_2O_3.CO_2 + 2(Fe_2O_3.3HO)$

When the desiccation was effected at 212° it afforded:

$3Fe_2O_3.CO_2 + 4HO$ or $Fe_2O_3.CO_2 + 2(Fe_2O_3.2HO)$

Dr. Wallace remarks, "when washed *until a very minute trace of soda existed in it*"—(the italics are mine). After being kept many weeks in water, dried, levigated, and rewashed, analysis gave the following composition:

$9Fe_2O_3.CO_2 + 12HO$ or $Fe_2O_3.CO_2 + 4(2Fe_2O_3 + 3HO)$

Soubeiran found a specimen exposed in a damp cellar for six months to yield $5Fe_2O_3.CO_2 + 12HO$. Langlois dried the salt at 212°, and found it contained only 1·36 per cent. of carbonic acid. I found the composition of the iron compound dried in the air to be:

	Atomic weight.	Theory.	Found.
3 equivalents of sesquioxide of iron . .	240	71·856	72·000
1 equivalent of carbonic acid	22	6·586	7·037
8 equivalents of water .	72	21·558	20·963
	334	100·000	100·000

Formula $3Fe_2O_3.CO_2 + 8HO$

Dried at 212° it gave me:

	Atomic weight.	Theory.	Found.
3 equivalents of sesquioxide of iron . .	240	80·540	80·770
1 equivalent of carbonic acid	22	7·370	7·250
4 equivalents of water .	36	12·090	11·980
	298	100·000	100·000

The preceding examinations were all most carefully performed under the direction of Dr. Muspratt, who with myself *cannot account* for the *whole* of the carbonic acid being removed from the alumina and *not from* the other two oxides; such however is the fact, as proved by the foregoing experiments, all of which were conducted on the same plan, and each precipitate was apparently submitted to the same conditions and treatment.

TECHNICAL CHEMISTRY.

On a Continual Indicator of the Specific Gravity of Gas, by Drs. J. Bosscha *and* L. C. Ledoir, *Leyden University.*

Several gas-engineers may have felt the want of an instrument of simple construction, serving to determine by an easy experiment, the more or less valuable qualities of gas issuing from different kinds of coal, and from coals of the same kind subjected to different degrees of heat.

Considering that the lighting power of gas, according to the experiments of Clegg and others, corresponds directly to its specific gravity, we tried a series of experiments with apparatus based on the principle just explained, but of different constructions, and at last succeeded in devising an instrument answering all the conditions required.

This apparatus simple in its application, may perhaps be found useful in gasworks. Its construction may be easily conceived by the following indications: A glass balloon having a volume of about half a litre (=30 cubic inches=1 wine pint) is hung at one end of a balance with an inflected beam, such as used for ascertaining the weight of letters. The accuracy and sensibility of this balance must be so great that variations in weight of one milligramme (=0·01 English grain) make themselves visible on the circular scale, over which the longest downwards inflected end of the beam moves.

The whole apparatus is placed under a glass vessel, having an in- and outlet for the coal-gas, and standing in a pneumatic trough.

It will easily be understood that if the vessel is filled with gases of different specific gravities at the same degree of heat and pressure, the beam of the balance will assume a different position, and each position will correspond to a different specific gravity of gas. Our scale is divided into equal degrees and their value fixed by filling the vessel first with pure hydrogen and afterwards with air. The weight of the glass balloon must be as low as possible; the one we made use of had, together with the hook, a weight of no more than 45 grains.

It seems not difficult for micro-chemical glass apparatus makers to blow balloons of the proportions just described, but they have the disadvantage of being very fragile.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of the Unguentum Hydrargyri Nitratis, (Ph. L.) by Julius Schweitzer.

No preparation of the London Pharmacopœia is more difficult to obtain of a constant and uniform appearance and consistence than the unguentum hydrargyri nitratis. The ingredients which enter into the composition of this ointment are lard, olive oil, mercury, and nitric acid; and it is directed to be prepared by first dissolving the mercury in the nitric acid, and then mixing the solution while hot with the lard and olive oil previously melted together. When successfully made the ointment should be, 1. of a pure pale yellow colour; 2. of a soft and uniform consistence; and 3. should be able to retain its colour and softness unchanged. When the acid mercurial solution is mixed with the melted lard and oil, we observe a chemical action accompanied by a rise of temperature to take place, which is more or less observable according—1. to the state of the mercurial solution; 2. to the temperature of the lard and oil at the time the solution is added; and 3. to the amount of stirring employed to effect the combination. The chemical action arises from the influence of the nitrous acid in the mercurial solution on the lard and oil. The warmer the fats, the richer the nitric solution in lower oxides of nitrogen, and the more energetic the stirring, the more sudden will the chemical action take place, and the higher will rise the temperature of the mixture; and on the contrary, the cooler the fats, the poorer the mercurial solution in nitrous acid, and without stirring, the mixture occasions scarcely any chemical action and rise of temperature at all. As a sudden and high temperature is always detrimental to the ointment, we must especially guard against this, which is perfectly in our power. But as we have to assist, and to some extent develope, chemical action to produce the ointment, we must remember, 1. that the *larger* the amount of nitrous acid in the solution the *lower* must be the temperature of the fats when the mixture is made, and 2. that the *poorer* in nitrous acid the *higher* may the temperature of the fats be. It must always be borne in mind, however, that ointments whose temperature in the making rises above 212° Fahr. will turn out dark in colour and hard in consistence, even if the colour and consistence is tolerably good when first made; but those which are made at a lower temperature will always prove unobjectionable in every respect.

I divide the preparation of this ointment into three periods. I allow the solution of the mercury in the nitric acid to go on slowly during the night. The next morning I melt the lard, and after the acid solution is added I watch the chemical action during the day. The following morning the preparation is finished in the manner hereafter described.

As the nitrous acid is the most essential agent in the formation of the ointment, I effect the solution of the mercury so as to lose as little of this acid as possible. I therefore allow the solution of the mercury to go on spontaneously in the cold and in a tall covered jar. I avoid hereby trouble and inconvenience; and in the morning I find a complete solution, cold and ready for use. In the morning I melt the lard on a water bath, strain it into an open glazed pan, and add the oil to it cold to lower the temperature. I stir the two well together, and wait until the mixture is about 130° Fahr., when I pour the mercurial solution gently into it, and allow the whole to stand undisturbed for some time. When the ointment begins to set at the sides of the vessel, and on the surface, I move these solid portions gently, and guide them into the warmer part, and wait again until it is necessary to repeat this operation, now and then drawing the spatula backwards and forwards through the entire mass. As the whole becomes firmer and firmer, I increase the stirring, and continue it at intervals through the whole day. The next morning I find a spongy mass with a high raised crust, rather harder than the interior portion, and generally a small quantity of acid liquid at the bottom of the pan. I now stir and beat the mass vigorously for some time until the spongy ointment softens under the spatula, and the liquid becomes thoroughly mixed, when the colour becomes of a beautiful canary yellow, and my care and trouble are rewarded with an ointment everything that can be desired in appearance and consistence. I have still to add a few words on the ingredients and materials which concern this ointment. First of all I select the finest and best lard, as the goodness of the ointment, its colour and keeping properties, depend a good deal on the quality of this article. Next, I avoid the use of all materials which are likely to be acted on by the acid solution. Even the wooden spatula of the laboratory I suspiciously discard for one of stone ware; and when I have my lard and oil, mercury and nitric acid in proper condition, my last look is to see that my vessels are really perfectly clean.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN[1].

Friday, 20 Jan. 1860.

On the Influence of Magnetic Force on the Electric Discharge. by John Tyndall, *Esq. F.R.S. Professor of Natural Philosophy in the Royal Institution.*

The intention of the speaker was to bring before the meeting a series of experiments illustrative of the constitution of the electric discharge and of the action of magnetism upon it. The substance of the discourse was derived from the researches of various philosophers, its form being regulated to suit the requirements of the audience.

1. The influence of the transport of particles was first shown by an experiment suggested, it was believed, by Sir John Herschel, and performed by Professor Daniell. The carbon terminals of a battery of 40 cells of Grove were brought within one-eighth of an inch of each other, and the spark from a Leyden jar was sent across this space. This spark bridged with carbon particles the gap which had previously existed in the circuit, and the brilliant electric light due to the passage of the battery current was immediately displayed.

2. The magnified image of the coal points of an electric lamp was projected upon a white screen, and the distance to which they could be drawn apart without interrupting the current was noted. A button of pure silver was then introduced in place of the positive carbon, a luminous discharge four or five times the length of the former being thus obtained. The silver was first observed to glow, and afterwards to pass into a state of violent ebullition. A narrow dark space was observed to surround one of the poles, corresponding probably with the dark space observed in the discharge of Ruhmkorff's coil through rarefied media.[2]

3. The action of a magnet upon the splendid stream of green light obtained in the foregoing experiment was exhi-

[1] The publication of Professor Faraday's sixth and last lecture, on the *Correlation of the Physical Forces*, is unavoidably delayed until next week.

[2] Mr. Faraday noticed this dark stripe while the speaker was making his preparatory experiments.

bited. A small horseshoe magnet of Logemann was caused to approach the light, which was bent hither and thither, according as the poles of the magnet changed their position: the discharge in some cases formed a magnificent green bow, which on the further approach of the magnet was torn asunder, and the passage of the current thereby interrupted. It was Davy who first showed the action of a magnet upon the voltaic arc. The transport of matter by the current was further illustrated by a series of deposits on glass obtained by Mr. Gassiot from the continued discharge of an induction coil.

4. A discharge from Ruhmkorff's coil was sent through an attenuated medium; and the glow which surrounded the negative electrode was referred to. One of the most remarkable effects hitherto observed was that of a magnet upon this negative light. Plücker had shown that it arranges itself under the influence of the magnet exactly in the direction of the magnetic curves. Iron filings strewn in space, and withdrawn from the action of gravity, would arrange themselves around a magnet, exactly in the manner of the negative light.

An electric lamp was placed upon its back; a horseshoe magnet was placed horizontally over its lens, and on the magnet a plate of glass: a mirror inclined at an angle of 45° received the beam from the lamp, and projected it upon the screen. Iron filings were scattered on the glass, and the magnetic curves thus illuminated were magnified, and brought to clear definition upon the screen. The negative light above referred to arranges itself, according to Plücker, in a similar manner.

5. The rotation of an electric current round the pole of a magnet, discovered by Mr. Faraday in the Royal Institution, nearly forty years ago, was next shown; and the rotation of a luminous current from an induction coil in an exhausted receiver by the same magnet was also exhibited, and both shown to obey the same laws.

6. Into a circuit of 20 cells a large coil of copper wire was introduced, and when the current was interrupted, a bright spark, due to the passage of the extra current, was obtained. The brightness and loudness of the spark were augmented when a core of soft iron was placed within the coil. The disruption of the current took place between the poles of an electro-magnet; and when the latter was excited, an extraordinary augmentation of the loudness of the spark was noticed. This effect was first obtained by Page, and was for a time thought to denote a new property of the electric current.

But Rijke had shown in a paper, the interest of which is by no means lessened by the modesty with which it is written, that the effect observed by Page is due to the sudden extinction of the primary spark by the magnet; which suddenness concentrates the entire force of the extra current into a moment of time. Speaking figuratively, it was the concentration of what, under ordinary circumstances, is a mere push, into a sudden kick of projectile energy.

7. The contact-breaker of an induction coil was removed, and a current from five cells was sent through the primary wire. The terminals of the secondary wire being brought very close to each other, when the primary was broken by the hand, a minute spark passed between the terminals of the secondary. When the disruption of the primary was effected between the poles of an excited electro-magnet, the small spark was greatly augmented in brilliancy. The terminals were next drawn nearly an inch apart. When the primary was broken between the excited magnetic poles, the spark from the secondary jumped across this interval, whereas it was incompetent to cross one fourth of the space when the magnet was not excited. This result was also obtained by Rijke; who rightly showed, that in this case also the augmented energy of the secondary current was due to the augmented speed of extinction of the primary spark between the excited poles. This experiment illustrated in a most forcible manner the important influence which the mode of breaking contact may have upon the efficacy of an induction coil.

The splendid effects obtained from the discharge of Ruhmkorff's coil through exhausted tubes were next referred to. The presence of the coil had complicated the theoretic views of philosophers, with regard to the origin of those effects; the intermittent action of the contact-breaker, the primary and secondary currents, and their mutual reactions, producing tertiary and other currents of a higher order, had been more or less invoked by theorists, to account for the effects observed. Mr. Gassiot was the first to urge, with a water battery of 3500 cells, a voltaic spark across a space of air, *before* bringing the electrodes into contact; with the self-same battery he had obtained discharges through exhausted tubes, which exhibited all the phenomena hitherto observed with the induction coil. He thus swept away a host of unnecessary complications which had entered into the speculations of theorists upon this subject.

8. On the present occasion, through the kindness of Mr. Gassiot, the speaker was enabled to illustrate the subject by means of a battery of 400 of Grove's cells. The tension at the ends of the battery was first shown by an ordinary gold-leaf electroscope; one end of the battery being insulated, a wire from the other end was connected with the electroscope; the leaves diverged; on now connecting the other end of the battery with the earth, the tension of the end connected with the electrometer rose, according to a well-known law, and the divergence was greatly augmented.

9. A large receiver (selected from Mr. Gassiot's fine collection), in which a vacuum had been obtained by filling it with carbonic acid gas, exhausting it, and permitting the residue to be absorbed by caustic potash, was placed equatorially between the poles of the large electro-magnet. The jar was about six inches wide, and the distance between its electrodes was ten inches. The negative electrodes consisted of a copper dish, four inches in diameter, the positive one was a brass wire.

On the 16th of this month an accident occurred to this jar. Mr. Faraday, Mr. Gassiot, and the speaker had been observing the discharge of the nitric acid battery through it. Stratified discharges passed when the ends of the battery were connected with the electrodes of the receiver; and on one occasion the discharge exhibited an extraordinary effulgence; the positive wire emitted light of dazzling brightness, and finally gave evidence of fusion. On interrupting the circuit, the positive wire was found to be shortened about half an inch, its metal having been scattered by the discharge over the interior surface of the tube.

10. The receiver in this condition was placed before the audience in the position mentioned above. When the ends of the 400-cell battery were connected with the wires of the receiver, *no discharge passed*; but on touching momentarily with the finger any portion of the wire between the positive electrode of the receiver and the positive pole of the battery, a brilliant discharge instantly passed, and continued as long as the connexion with the battery was maintained. This experiment was several times repeated: the connexion with the ends of the battery was not sufficient to produce the discharge, but in all cases the touching of the positive wire caused the discharge to flash through the receiver.

Previous to the fusion of the wire above referred to, this discharge usually exhibited fine stratification: its general character now was that of a steady glow, through which, however, intermittent luminous gushes took place, each of which presented the stratified appearance.

11. On exciting the magnet between whose poles the receiver was placed, the steady glow curved up or down according to the polarity of the magnet, and resolved itself into a series of effulgent transverse bars of light. These appeared to travel from the positive wire along the surface of the jar. The deflected luminous current was finally extinguished by the action of the magnet.

12. When the circuit of the magnet was made and immediately interrupted, the appearance of the discharge was extremely singular. At first the strata rushed from the positive electrode along the upper surface of the jar, then stopped,

and appeared to return upon their former track, and pass successively with a deliberate motion into the positive electrode. They were perfectly detached from each other; and their successive engulphments at the positive electrode were so slow as to be capable of being counted aloud with the greatest ease. This deliberate retreat of the strata towards the positive pole was due, no doubt, to the gradual subsidence of the power of the magnet. Artificial means might probably be devised to render the recession of the discharge still slower. The rise of power in the magnet was also beautifully indicated by the deportment of the current.

After the current had been once quenched, as long as the magnet remained excited no discharge passed: but on breaking the magnet circuit the luminous glow reappeared. Not only then is there an action of the magnet upon the particles transported by an electric current, but the above experiment indicates that there is an action of the magnet upon the electrodes themselves, which actually prevents the escape of their particles. The influence of the magnet upon the electrode would thus appear to be *prior* to the passage of the current.

13. The discharge of the battery was finally sent through a tube whose platinum wires were terminated by two small balls of carbon: a glow was first produced; but on heating a portion of the tube containing a stick of caustic potash, the positive ball sent out a luminous protrusion, which subsequently detached itself from the ball; the tube becoming instantly afterwards filled with the most brilliant strata. There can be no doubt that the superior effulgence of the bands obtained with this tube is due to the character of its electrodes; *the bands are the transported matter of these electrodes*. May not this be the case with other electrodes? There appears to be no uniform flow in nature; we cannot get either air or water through an orifice in a uniform stream; the friction against the orifice is overcome by starts, and the jet issues in pulsations. Let a lighted candle be quickly passed through the air; the flame will break itself into a beaded line in virtue of a similar intermittent action, and it may be made to sing, so regular are the pulses produced by its passage. Analogy might lead us to suppose that the electricity overcomes the resistance at the surface of its electrode in a similar manner, escaping from it in tremors; the matter which it carries along with it being broken up into strata, as a liquid vein is broken into drops.

SOCIETY OF ARTS, *Wednesday, 1 Feb.* 1860.

THE paper read at this meeting was one by DR. MACGOWAN *On the Arts and Manufactures of Japan*, and though short was highly interesting, being illustrated by numerous specimens of varied nature and importance. After a few remarks upon the remarkable geological features of the island and the attractions it offers to the scientific man, the doctor says:

"I cannot better introduce the subject than by showing this Japanese work, an encyclopædia, entitled *The Wonderful Productions of the Seas and Hills*, evidencing, by the subjects treated and the merit of the typography, their advance in arts and knowledge, filled with spirited cuts of almost every industrial pursuit, commencing with mining, and concluding with whaling, an operation in which we find seamen and shore-men jointly engaged, the former wielding harpoons, the latter employing huge nets.

Let us, in imitation of our methodical encyclopædist, commence with metallurgy.

Gold is abundant in Japan, bearing the relation to silver as 1 to 5, instead of as 1 to 15, as elsewhere. Indeed, the last mail brings intelligence to the effect that silver had been exchanged for gold, weight for weight. This in itself does not demonstrate the existence of extensive auriferous deposits; the abundance of the metal may possibly be the consequence of gradual accumulation, being pent up, as it were, by the system of seclusion so long persevered in by that sagacious people.

These volumes, six in number, afford another illustration of the advanced state of the arts in Japan. It is a work on Numismatics. The elegance of the coloured pictures of the various coins—gold, silver, and copper—of different periods and various principalities is remarkable.

Gold-dust is found in the south of Jesso, in the province of Sado.

The silver coin, or *Ichibu*, is of a very peculiar figure. This metal is found in Dewa, Sado, and Tasimo. It does not appear to be abundant at present, but it promises to become so, from the dollars that are pouring into Nagasaki and Kanagawa from China, Japan coming in for a large share of the drain of silver to the East that now attracts general attention.

Japan, as is well known, is remarkable for its richness in copper.

The first thing which attracts the traveller on landing is the great abundance of this metal and the plentiful manner in which it is used. The gutters and shutters for the houses are of copper; the pillars and verandahs are protected with the same metal. The monumental gateways in the cities are often of copper, and the idols in the temples are formed of the same material; and even before landing the traveller would notice that the vessels are sheathed in all parts with copper — in many instances more for ornament than for use.

If restrictions were not placed upon the exportation of that metal from Japan the markets of the world would be glutted with it for a time. The Japanese are very expert in blending copper with other metals, as shown by the various specimens of bronzes before you.

In iron the Japanese are most deficient. Much of their iron is obtained, as in some parts of China, by washing the sands of the rivers. In the summer season multitudes of men, women, and children may be seen washing the sand, and they take all this pains to get a few specks of black oxide of iron, which is subsequently melted and forged for the purposes of their manufactures. As might be expected from this state of things with regard to iron, their cutlery is of a very inferior description, with the exception of swords, which are in many instances very costly, both from their superior workmanship, and the large amount of gold used in their ornamentation."

This method of working iron-ores, seems especially strange to English ears, but the narrative carries with it an example of a great and important truth, viz. — that the physical properties of a metal, or indeed of any natural production, form the only true criterion of its value, which is not dependant so much upon the comparative abundance or scarcity of the substance itself. Among other things Dr. Macgowan exhibited a carpenter's saw and file, a small reaping hook, and two costly swords, of native manufacture; attached to the scabbard of one of the latter was "a small knife, used for what is known as the *Slowi-kari*, or *happy despatch*, that is, self-evisceration."

Calling attention to the peculiarities of these weapons, the lecturer observed: —

"It is stated that these swords will sever a nail without being notched. They are made out of good bar steel, and tempered by being covered with a paste consisting of powdered porcelain, charcoal, and potash, dried in the sun, brought to a white heat, and then plunged into tepid water. The shagreen on the handle, the massive gold ornamentation, and above all the singular mode of combining gold and iron in decorating the hilt, are all worthy of notice."

The information relating to other mineral productions was given as follows: —

"There are also mines of antimony, tin, lead, and mercury, and perhaps no country in the world of the same area presents so many volcanoes in operation. Sulphur, of course, is very abundant. But, what is more important for civilisation and Christianity as well as for the commerce of the Pacific, coal is found in considerable abundance.

This precious mineral, so necessary for the commerce and

civilisation of the Pacific, is found in nearly all the islands which girt eastern Asia, from Borneo to Sagallen. The first-named locality has fallen into the hands of the British, the last-named, probably the richest, has become Russian property. The Chinese in Formosa and the Japanese at home, will, it is to be hoped, furnish supplies of coal, should either of the others fail for a season. I have visited several of the mines in Japan, and am inclined to attribute the inferiority of the mineral to unscientific mining.

The Japanese themselves have not been insensible of this, and at once ordered, through the Dutch, suitable machinery, but either the machinery was defective, or the requisite skill was wanting for rendering it available. I saw some of it rusting at Desima, and found the miners labouring at every disadvantage, under circumstances, I may add, calculated to throw doubts on the glowing accounts that have been rendered of the comfortable condition of the labouring class in that country.

On the coast of Fizen, I believe, there is as much suffering amongst the labouring classes of Japan as in any part of the world. I have seen them, on a bitter cold day, the children naked and the women nearly so, crawling on all-fours up a hill side, dragging small coal-cars attached to their loins, and I longed for the time when machinery would be brought to their aid."

Passing to the vegetable kingdom the doctor showed some specimens of hard woods, which he said would be very valuable to our shipmasters, carpenters, &c. if they proved to be abundant. The "vegetable wax, "Japan varnish," and the "paper mulberry," were all noticed in their turn, and some interesting fabrics of silk and cotton exhibited, as well as some specimens of edible seaweed, in which latter article a large trade is carried on with China. In conclusion, Dr. Macgowan adverted to the probable introduction of opium into Japan, and lamented the evils that would inevitably follow the use of the drug in large quantities by the ingenious but rather sensual inhabitants. The meeting terminated with a vote of thanks to the doctor for his paper.

If we were inclined to review the paper critically, we might perhaps point out some important omissions, as little or no mention was made of the more artistic accomplishments of the Japanese. Their style of art is certainly peculiar and original, being easy and natural, without displaying either that wearying uniformity so common in our schools of design on the one hand, or the least tendency towards the doctrines of the pre-Raphaelite system on the other. But a few years back we had an opportunity of inspecting some ceramic work of Japanese origin, of which the material, colouring, and design were alike admirable. Among these specimens were some vases, saucers, &c. with natural objects of a simple kind reproduced with exquisite delineation upon their surfaces. There would appear, for instance, on a dark red or claret ground, a large leaf of delicate hue, *not placed exactly in the middle with a border all round*, but easily and gracefully lying on the saucer, as if it had settled there accidentally; sometimes a lizard or other small animal would also be depicted, but if the object happened to be too large for the diameter of the vessel, it would be carried over the edge and completed on the other side. In a word, both in the ceramic and textile manufactures that we had the pleasure of examining, the leading features were a finished detail and an entire absence of artificiality. We think that British art may some day learn a useful lesson from the "Land of the Rising Sun," and the Committee of Council on Education would do well to place a really good and comprehensive collection of Japanese productions at the South Kensington Museum for the public benefit at the earliest opportunity.

Of the scientific attainments of the Japanese we can gather little or nothing from Dr. Macgowan's paper, but his future lectures may perhaps give us more information upon this subject.

PHARMACEUTICAL SOCIETY, 1 *Feb.* 1860.

T. N. R. Morson, Esq. *President, in the Chair.*

Mr. D. Hanbury Junr. exhibited a large mass of Gum Labdanum, which he had received from Candia. It was formerly in great repute as a remedy for the plague; but since the plague has disappeared the gum is neglected, and is now not often to be met with.

Professor Bentley called the attention of the meeting to a paper *On Camomiles* which had been published in France, in which it was asserted that the Chamomilla Romana (as our Anthemis Nobilis is called on the continent) is extensively adulterated with the flowers of Matricaria Parthenium or Pyrethrum Parthenium. The Professor exhibited some of these flowers, and explained the distinctive characteristics of the Pyrethrum and the Anthemis Nobilis. The flowers greatly resembled each other in general appearance, the involucrum in both was hemispherical and scaly; but the anthemis nobilis was distinguished by a conical receptacle which the pyrethrum did not possess.

Mr. Hanbury said the flowers were so much alike that purchasers might be readily deceived, taking the matricaria parthenium for poor or bad camomiles.

Dr. Redwood then proceeded to give an account of some experiments on *Hydrargyrum cum Cretâ*, which he had undertaken in consequence of the statements made on the trial of Dr. Smethurst, that this medicine commonly contained arsenic and antimony. He also referred to a letter published in the *Medical Times and Gazette*, in which the writer affirmed that *Hydrargyrum cum Cretâ* was often prepared with the refuse amalgam of looking-glass makers, from which it was possible that the foreign metals might be derived; and that he and other medical men had been compelled to give up the use of this medicine in consequence of the severe vomiting and other disagreeable effects which they had constantly observed to follow its administration. Dr. Redwood had obtained from various sources different specimens of the medicine, some of them from the largest manufacturers of the article in London, and some which had been in commerce at a time antecedent to the death of Miss Banks. He had submitted all these specimens to a most rigid examination, and the result was that he had been unable to discover the faintest trace of either arsenic or antimony. The tests were so extremely delicate, and the reagents used in the examination were so often themselves contaminated with arsenic, that it was far more probable the small quantity of this metal one gentleman said he had found was derived from the latter than from the grey powder under examination. Dr. Redwood then, on the supposition that it was a common opinion among medical men that the effects of *Hydrargyrum cum Cretâ* were different at the present time from what they used to be years ago, proceeded to account for and explain the fact. He believed that it was a consequence of the different method of manufacture pursued. Formerly the mercury and the chalk were merely rubbed together in a mortar until the mixture of the two was complete; but now, in the wholesale manufacture by machinery, the ingredients were submitted to much more trituration, and the result, he believed, was the formation of much more oxide of mercury, and to this he thought the symptoms complained of might be ascribed. The assertion that the refuse amalgam of looking-glass makers was used in the preparation he believed to be a mistake; but if it were true that would not account for the presence of arsenic, inasmuch as the tin used in the manufacture must be absolutely pure. A mixture of bismuth, arsenic and antimony, a sort of fusible metal, was used for silvering glass globes, but no mercury was used in that process. Moreover, mercury and arsenic only amalgamated with great difficulty, and then the amalgam did not possess the brilliancy necessary for looking-glasses; in fact, the presence of a very small quantity of arsenic would be indicated by the physical appearance of the amalgam.

The Chairman said it was well known that the refuse amalgam of the looking-glass makers and the scrapings of broken-

looking-glasses were collected, and the mercury distilled off; but there could be no objection to the use of this mercury, inasmuch as it would be pure. The difference in the effects of the medicine he attributed to the method of manufacture. The original process produced an inactive, the new method an active medicine.

Dr. ANDREW CLARK said that the two professions were equally indebted to Dr. Redwood for the examination he had undertaken. The injury done by rash statements of the kind noticed was very great. He had used *Hydrargyrum cum Cretâ* largely himself, and he had very carefully observed the results. In his hospital practice he was in the habit of seeing about 600 patients weekly, and he though the prescribed grey powder for 250 of them, but he had never seen the bad effects which had been ascribed to the medicine.

Mr. CUPISS said he had administered a good deal of grey powder, and he had never seen nausea or vomiting produced by it even in the most delicate children. Those who had seen these effects he thought had been peculiarly unfortunate either in their patients or their drugs.

At the end of the meeting Dr. Redwood said he was still occupied with the investigation, and he would feel obliged if any members would send him specimens of *Hydrargyrum cum Cretâ*, particularly if they had been in stock prior to the trial of Dr. Smethurst.

CHEMICAL SOCIETY, 2 *Feb.* 1860.

[Dr. BENCE JONES *in the Chair.*

Dr. GLADSTONE read a paper on an *Iron-sand from New Zealand*. It was found on the shore at New Plymouth, and formed a bank several miles in length and upwards of 40 feet in depth. It was highly magnetic. Examined with the microscope it exhibited small granules of a lustrous black colour which had a distinctly crystalline form belonging apparently to cubic octahedra. To the crystals were attached very minute particles of quartz. An analysis showed the sand to have the following composition (omitting the smaller decimals):

Magnetic oxide of iron	94·0
Silica	3·5
Alumina	1·5
Lime	·5
Various matters and loss	·5
	100·0

It was therefore magnetic oxide of iron in combination with silicate of alumina and lime. Dr. Gladstone said that the occurrence of magnetic oxide in a crystalline form was not infrequent. The sand he thought was the result of the disintegration of some mineral, most likely epidote or garnet.

Mr. FEWTRELL said that the government of New Zealand had offered a premium of a thousand pounds for a process for smelting the sand exhibited.

From a subsequent conversation we learned that the premium had been claimed by a gentleman who was present at the meeting, and that the government of New Zealand had further granted a large tract of forest land to furnish charcoal for the smelting works. There was plenty of limestone in the immediate neighbourhood, and it was expected that the furnaces would soon be in active operation.

Dr. FRANKLAND then read a paper *On the Air of Mont Blanc*. He first gave some account of various analyses of air of different localities; those by Bunsen of the air at Marburg—by Lewey of air taken at sea, and by Schlaginweit among the Eastern Alps. Bunsen had found from a number of experiments that the oxygen present in 100 parts of air ranged from 20·840 to 20·973. The results obtained by Lewey from air taken at sea at 3 P.M. and 3 A.M. were:

	½ P.M.	3 A.M.
Nitrogen	78·886	79·006
Oxygen	21·060	20·961
Carbonic acid	0·054	0·033
	100·000	100·000

The determinations of carbonic acid in the air of the Eastern Alps by Schlaginweit showed in one experiment 0·32 and in another ·058 per cent; but from the manner in which these determinations were made they were not considered of any value. The doctor then said that having ascended Mont Blanc last autumn with Dr. Tyndall, he had taken the opportunity of collecting some air, which he had submitted to analysis, and the results were as follows:

	Grands Mulets.	Summit.	Chamounix.
Nitrogen	79·119	78·989	79·056
Oxygen	20·770	20·950	20·881
Carbonic acid	·111	0·061	0·063
	100·000	100·000	100·000

A diagram was exhibited, showing determinations of oxygen and nitrogen in the air of different localities, by Regnault, Dr. Frankland, and others, some of which we append:

	Oxygen.	*Nitrogen.*
London (Bartholomew's Hospital)	20·885	79·115
	20·999	79·001
Paris	20·913	79·087
	20·999	79·001
Ganges	20·387	79·613
	20·390	79·610
Polar Sea	20·850	79·150
	20·940	79·060

Mr. PERKINS read a paper on *Iodoacetic and Di-iodoacetic Acids and Salts.*

NOTICES OF BOOKS, PATENTS, &c.

Electrotype Manipulation: Part I. Being the Theory and Plain Instructions in the Art of Working Metals by Precipitating them from their Solutions through the Agency of Galvanic or Voltaic Electricity, by C. V. WALKER, *F.R.S. &c. &c. Twenty-ninth Edition.* London: G. Knight & Co.

THE sale of twenty-eight editions of a book is an evidence of its value sufficient to make it quite independent of the commendations of a reviewer. Almost ever since the invention of the art, Mr. Walker's little work has been the text book of every amateur who has begun to experiment in electro-metallurgy, and we can do no better than recommend all who may begin to start with the same manual.

No two discoveries have ever had so great an influence in developing and promoting a taste for the fine arts as the electrotype and photography; but the practical applications of the electrotype have placed it in importance far in advance of its twin discovery. That we have first class maps of fabulous cheapness, that the Art Union can multiply to any extent the productions of our best engravers, and that our low priced periodicals can furnish engravings which surpass in beauty and accuracy the most expensive works of the kind of twenty years ago, we owe to the electrotype. Sanguine as discoverers proverbially are, Mr. Spencer, we imagine, at first little dreamed of the importance of the discovery he had accidentally made. But in his hands it immediately received its most valuable application, and in his paper published in 1839 may be found the germs of almost all that has since been done. Simultaneously with Mr. Spencer's discovery, Professor Jacobi of St. Petersburgh invented a method of converting any line, however fine, engraved on copper, into a relief by a galvanic process; and to these two gentlemen must be awarded the honour of having made one of the most important discoveries of modern times.

It would be interesting, if our space permitted, to trace the rapid development of an art which now ministers to our daily enjoyment—for in some shape or other, the results of the electrotype are ever before our eyes — but we are obliged to forbear. We cannot however pass without notice one unexpected and important sanatory result. The power which

"takes a cast of the eye of a dragon-fly so perfect that under the microscope it exhibits the innumerable facets of the compound eye," and which could with as much ease cover the dome of St. Paul's with gold, if it could only be placed in an apparatus sufficiently large, has banished the old process of water-gilding, which sometimes produced in he operatives the miserable disease known as mercurial intoxication. The mercurial process is now only used for silvering mirrors, and it may be safely predicted that this will in a short time be superseded.

We return to Mr. Walker's book for a description of a *Platinised Graphite Battery* for electrotype purposes, which forms the most important feature of the present edition. Plates of graphite of the required size obtained from gas retorts, are immersed in a mixture of one part of sulphuric acid, and four parts of water, for at least a couple of days and nights. They are then rinced in water and dried. A hole is then drilled in each plate to receive a rivet. The top of the plate is then varnished on either side of the rivet hole, and on both sides of the plate. About an inch in width on both sides in the middle having the rivet-hole in the centre is to be left unvarnished. Electrotype copper is now to be deposited upon the part that is left unvarnished, the object being to provide a surface to which a connecting slip of copper can be soldered. A slip of copper about an inch in width is then prepared and entirely tinned. The copper that has been deposited on the graphite plate is tinned in like mauner. The object of this is to screen the copper from the action of the acid. The slip of copper is next attached to the graphite plate by means of a copper rivet, which has been previously tinned; and then by means of the soldering iron. A strong and perfect connection is thus obtained. The plates are next platinised. A mixture of one part of sulphuric acid and ten of water is prepared. Into this are dropped a few crystals of chloride of platinum, till the liquid acquires a pale straw colour. A battery of three or four Lince's cells is prepared. The graphite plate is connected with the zinc end of the battery, and a couple of platinum plates are connected with the other end. The graphite is placed between the pair of plates, and in a decomposition cell, and the solution of chloride of platinum is poured in till the graphite plate is sufficiently immersed. In from twenty minutes to half an hour the surface of the graphite will be coated with fine black particles of platinum powder. The battery cells are stone jars. The zinc plates are well amalgamated, and are placed with their foot in mercury, contained in a gutta-percha slipper. Batteries of this kind, adds Mr. Walker, are very inexpensive, and are very economical in use.

A Set of Labels for Reagents, and a Table of Atomic Weights of the Elements, intended to accompany Messrs. Nothcote *and* Church's *"Manual of Analysis."* J. H. and J. Parker, Oxford, and 337 Strand, London.

These labels will be found useful to every student who works with the *Manual* of Messrs. Northcote and Church, and he had better fix them under the old names until he becomes thoroughly conversant with the new nomenclature. In this way he will be saved some time and thought, and by constantly reading the formulæ he will soon have them firmly impressed on his memory.

The table of atomic weights should be fixed on a card and suspended in a convenient place, ready for constant reference.

The Practice of hiring Wet-nurses (especially those from the "Fallen") considered as it affects Public Health and Public Morals. Churchill, London.

Wet-nursing is altogether out of our province, and all we can say of this little book is, that the intentions of the authoress are evidently of the very best. We may, however, in illustration, append a story quoted by Southey from Hoare's *Giraldus*.

"In our days a strange occurrence happened in the same district. A wild sow, which by chance had been suckled by a bitch famous for her nose, became so wonderfully active in the pursuit of wild animals, that in the faculty of scent she was greatly superior to dogs who are assisted by natural instinct as well as by human art: an argument that man (as well as every other wild animal) contracts the nature of the female who nurses him."

From the above rather apocryphal story, the practice of hiring wet-nurses from a certain class might be considered as being highly dangerous to the morality of the rising generation.

Improvements in rendering Fabrics and other Substances non-inflammable. Frederick Versmann and Alphons Oppenheim.

Messrs. Versmann and Oppenheim have only patented the use of sulphate of ammonia. They use a solution containing 10 per cent. of the sulphate and apply it to the goods after they have undergone other finishing processes, dipping the goods therein till they are fully saturated, and then drying them. When applied to nets and gauzes with comparatively thick threads and open spaces between them, the patentees use a stronger solution. A neutral solution of the sulphate must be used. The improvements also relate to the application of sulphate of ammonia with starch or other thickening agents.

Recovering Wool from Fabrics.

A patent has been taken out by R. Bell, for recovering wool from old worn-out clothes composed of cotton and wool, such as de-laines. The patentee takes chloride of manganese, such as is ordinarily obtained as a residuum in the manufacture of bleaching-powder; the rags to be treated are then steeped in a solution of this, which entirely decomposes the vegetable or cotton portions and leaves the woollen fibres uninjured. The liquid is then strained through a sieve to retains the wool, which is afterwards washed, dried, and may be used for shoddy or other purposes in making new goods out of old materials, just as new paper is made out of old rags.

Improvement in the Manufacture of Starch.

A patent has recently been obtained by John Hamilton of Belfast for submitting starch — after it is deposited in the manufacturing process — to the action of a hydraulic press, in suitable boxes, so as to press all the water out of it, instead of evaporating all the moisture in artificially heated rooms, according to the usual practice. A great saving in fuel is thus effected by well known and very simple means.

An Improvement in the Manufacture of Cast Steel. R. Mushet.

This consists in producing a superior quality of cast steel by melting malleable iron together with carbonaceous matter and ores, or oxides of titanium or titaniferous iron ores, or titanic acid, or deoxidised titaniferous iron ores.

CORRESPONDENCE.

Chemical Symbols for Druggists' Labels.

To the Editor of the Chemical News.

Sir, — My proposal will no doubt be sufficiently laughed at. and I grant that chemical symbols would be quite inapplicable in very many cases — for instance, tincture of rhubarb could not be well expressed thereby. But I think that they might be often employed with advantage. If plain language must not be used, if hieroglyphics of some sort are necessary, at least let the label, when possible, show the full composition

of the substance. It seems to me that $MgO.SO_3$ would be equally mysterious as Magnes. Sulph., and much more sensible. And would not a druggist's assistant, who learns from the former that sulphate of magnesia is the oxide of a metal combined with an acid, gain more knowledge than from the Dog-Latin of the latter? —I am, &c.

F. C. S.

Mutual Reaction of Salts in Solution.

To the Editor of the CHEMICAL NEWS.

SIR,—An answer is requested to the following query, viz.: What is the reaction of chloride of ammonium on nitrate of potassium?

$$xNH_4Cl + KNO_6 = ?$$

E. G.

[The question which E. G. proposes merits particular notice, and may be profitably discussed. In all cases where no precipitate is produced on mixing two or more salts, where no crystals are deposited or where no gas is evolved, it would appear that the proportions in which the acid and basic constituents of the original salts combine together and rearrange themselves are constant, and that they are independent of the original arrangement. The following conclusions, drawn by Dr. Gladstone from a very extended series of experiments on this subject, embrace almost all that is yet known about it.

The proportions in which the several acid and basic constituents of the salts employed will finally arrange themselves "are not merely the resultant of the various strengths of affinity of the several substances for one another, but are dependent also on the mass of each of the substances in the mixture.

"An alteration in the mass of any one of the binary compounds present alters the amount of every one of the other binary compounds, and that in a regularly progressive ratio; sudden transitions only occurring when a substance is present which is capable of combining with another in more than one proportion.

"This equilibrium of affinities arranges itself in most cases in an inappreciably short space of time, but in certain instances the basic and acid constituents do not attain their final state of equilibrium for hours or even days.

"The phenomena that present themselves where precipitation, volatilisation, crystallisation and perhaps other actions occur, are of an opposite character, simply because one of the substances is thus removed from the field of action, and the equilibrium that was first established is thus destroyed.

"There is consequently a fundamental error in all attempts to determine the relative strength of affinity by precipitation; in all methods of analysis founded on the colour of a solution in which colourless salts was also present; and in all conclusions as to what compounds exist in a solution drawn from such empirical rules as that 'the strongest base combines with the strongest acid.'"

These conclusions are chiefly based upon experiments in which the changes of colour in many coloured salts were examined under conditions which were varied in the most ingenious manner. Advantage was also taken of the different degrees of fluorescence or epipolism exhibited by certain quinine salts when other substances were introduced into their solutions. Dr. Gladstone's paper on the subject is to be found in the *Philosophical Transactions for* 1855, p. 179; while some more remarks further illustrative of the reciprocal decomposition of salts in solution is contained in the *Quarterly Journal of the Chemical Society for* 1856, p. 144. Dr. Gladstone is, we believe, still pursuing the investigation.

To return to the individual reaction mentioned by E. G. The equation given below may perhaps be taken as expressing the final qualitative arrangement of the several acid and basic constituents present.

$$(NH_4Cl + KNO_6) = (x-y)(NH_4Cl + KNO_6) + y(NH_4NO_6 + KCl).$$

It must however be assumed that the solutions of chloride of ammonium and nitrate of potassium are sufficiently dilute to prevent that precipitation of chloride of potassium which would otherwise occur. Suppose that the water were not more than sufficient to retain in solution the NH_4Cl and KNO_6 originally concerned,—when by the mutual action of these salts KCl is formed, a portion of it would be precipitated, since compared with NH_4Cl it requires at the boiling temperature, for instance, double the weight of water for solution.

The equation (to which we have referred above) does not pretend to express the proportions in which the NH_4NO_6 and KCl stand to the NH_4Cl and KNO_6; it assumes, however, that the two new salts, NH_4NO_6 and KCl, are produced in equivalent proportions.—ED.]

Chemical Notices from Foreign Sources.[1]

I. MINERAL CHEMISTRY.

Acids of Phosphorus and Arsenic.—MM. Hurtzig and Geuther[2] have succeeded in transforming tribasic phosphoric acid into pyrophosphoric acid in the moist way by the following method. Yellow phosphate of silver is dissolved in phosphoric acid, and the solution is evaporated. After a time some white scales are deposited, which are separated. The mother liquor is then concentrated afresh, until it has the appearance of a thick syrup when cold. This is treated with ether, and heated to boiling, when there separates a white crystalline powder, which is washed with alcohol to remove the excess of phosphoric acid. The powder, which is not altered by water, is the pyrophosphate of silver $2\,AgO.PO_5$.

By the action of phosphoric acid on the tribasic phosphate of silver there is no doubt formed $\left.\begin{matrix}2AgO\\HO\end{matrix}\right\}PO_5$, which by losing the water under the combined influence of heat and phosphoric acid in excess, is converted into pyrophosphate. The authors have not succeeded in changing pyrophosphate into metaphosphate under the influence of an excess of phosphoric acid.

Arseniate of Silver. — The brown arseniate of silver dissolves easily in a solution of arsenic acid. When this solution is evaporated and kept for some days at a high temperature, there separates a white crystalline powder, which washed with alcohol and dried has the composition expressed by the formula $AgO.2\,AsO_5$. Water decomposes this salt slowly when cold, quickly when hot, into the brown arseniate and arsenic acids.

Action of Perchloride of Phosphorus on Arsenious and Arsenic Acids. — By the reaction of perchloride of phosphorus on arsenious acid, oxychloride of phosphorus and chloride of arsenic are formed, according to the equation:

$$2\,AsO_3 + 3\,PCl_5 = 3\,PO_2Cl_3 + 2\,AsCl_3.$$

When anhydrous arsenic acid is treated with perchloride of phosphorus, there is also formed chloride of arsenic and oxychloride of phosphorus, and chlorine is set at liberty.

$$2\,AsO_5 + 5\,PCl_5 = 2\,AsCl_3 + 4Cl + 5\,PO_2Cl_3.$$

Different States of Silica. — Rose's object in the present memoir[3] is to call the attention of chemists to the isomeric states of silica. Silicic acid presents itself in two states, essentially distinct, and characterised by differences in density and chemical properties. Crystallised silicic acid has a density of about 2·9, and is attacked with difficulty by potash and even by hydrofluoric acid. Rock crystal, quartz, chalcedony, flint, sandstone, and quartzose sand belong to this modification. Amorphous silica dissolves very easily in solutions of potash and soda, and possesses a density = 2·2. This second modification includes gelatinous

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[1] We are requested to state that these articles are no longer communicated by Dr. T. L. Phipson.

[2] *Annalen der Chemie und Pharmacie*, v. xxxv. 1859.

[3] *Poggendorff's Annalen*, No. 9. v. cviii.

silica, pulveralent silica resulting from the decomposition of certain minerals, or from the decomposition of fluoride of silicon by water, opals, silica from the carapaces of infusoria, and melted quartz. Amorphous silica has a strong tendency to combine with water, and retains a part of it at temperatures above 212° Fahr.

A perfectly transparent piece of rock crystal exposed to a temperature estimated at 2000° Cent. will not melt, nor will it undergo any change of weight and density. But if the crystal be cracked or if it be powdered, and then exposed to the same temperature, it is transformed into amorphous silica, and the the calcined powder has a density of only 2·394. When rock crystal or quartz is completely fused beads or melted masses are obtained which have a density = 2·2 and dissolve as easily as amorphous silica in alkaline leys or even in a solution of carbonate of soda. These facts exclude the idea that rock crystal or quartz has been formed by fusion. The experiments of MM. Senarmont and Daubrée show that crystallised silica is only formed in the presence of water.

Concentrated fuming hydrofluoric acid evolves heat and boils in contact with silica which has a density = 2·2, but dissolves slowly and tranquilly a finely powdered silica of a density = 2·6.

II. ORGANIC CHEMISTRY.

Kava. — Kava, as the root of the Piper Methysticum is called by the South Sea islanders, is used by them in the preparation of an intoxicating drink. A specimen of the root has been submitted to a chemical examination by M. Gobley[4] who found it to be composed of

Water	15
Cellulose	26
Starch	49
Methysticine	1
Resin (acrid and aromatic)	2
Extractive matter	3
Chloride of potassium	1
Magnesia, silica, alumina, oxide of iron	3
	100

Methysticine is obtained from an alcoholic extract of the root by treating it with hot alcohol, which cooled slowly yields needle-like crystals of a yellow colour. Purified by repeated crystallisations from boiling alcohol, it is procured in the form of white silky needles, which have neither smell nor taste. It is insoluble in water, and but very slightly soluble in alcohol and ether at the ordinary temperature. Boiling alcohol completely dissolves it, but it almost entirely separates on cooling. Hydrochloric acid dissolves and colours it yellow. Nitric acid colours it first yellowish and then orange. Pure sulphuric acid produces a beautiful violet, and the commercial acid a blood-red colour. The composition of methysticine is:

Carbon	62·03
Hydrogen	6·10
Nitrogen	1·12
Oxygen	30·75
	100·00

The resin which is separated from the Methysticine in the repeated crystallisations of the latter is of a greenish yellow colour, has a strong aromatic odour, and a sharp acrid taste. It is insoluble in water, easily soluble in alcohol and ether. Sulphuric acid colours it an intense red, which lasts for some time.

According to Dr. O'Rocke, kava is one of the most powerful sudorifics known. Like the other peppers also, it is useful in catarrhal affections.

Action of Chloride of Lime on some Compound Ethers. — M. Schlagdenhauffen[5] has shown, that the acetates and tartrates of ethyl and methyl, the formiate and nitrate of ethyl, the oxalates of ethyl and methyl, and the benzoate of ethyl furnish chloroform when distilled with a mixture of lime and chloride of lime.

III. CHEMICAL ANALYSIS.

Separation of Peroxide of Iron and Oxide of Copper by Ammonia. — When peroxide of iron is precipitated by ammonia in the presence of oxide of copper, the first always carries down with it a considerable quantity of the second, which cannot be got rid of by washing. M. Loewe[6] says that the two may be completely separated by redissolving the well washed oxide of iron, and precipitating it a second time with ammonia.

Estimation of Silver, Lead, Mercury, Bismuth, and Cadmium, in the state of Sulphurets. — When these metals are precipitated from acid solutions by sulphuretted hydrogen, there is nearly always a mixture of sulphur, which interferes with the correct estimation. M. Loewe[7] has shown that the inconvenience may be remedied by treating the precipitate with a hot moderately concentrated solution of sulphite of soda, which dissolves the sulphur in changing into hyposulphite. The addition of a small quantity of hyposulphite appears to favour the solution of the sulphur.

[4] *Journal de Pharmacie et de Chimie*, Jan. 1860.
[5] *Ibid.*
[6] *Journal für Praktische Chemie*, lxxvii. p. 77.
[7] *Ibid.*

SCIENTIFIC NOTES AND QUERIES.

Magnetic Peroxide of Iron.—Sir, — A correspondent in a recent number (p. 95) directs my attention to the following quotation from Brande's *Manual* on peroxide of iron.

"When however it has been long and strongly heated it sometimes becomes magnetic."

The product so obtained can in no way be considered similar to the magnetic peroxide of iron described in the first number of the Chemical News, p. 11; in the latter it is not a small portion that is converted into that state but every particle of it is strongly magnetic.

Should *W. G.* be disposed to take the trouble to examine those portions which are sometimes found in the former, I think he will find them to consist of a mixture of peroxide and protoxide caused by loss of oxygen from the excessively high temperature employed. Were precautions taken to prevent access of oxygen during the act of cooling, a much larger proportion would no doubt be found in that condition.

I have subjected peroxide of iron to a white heat for upwards of an hour, but find that temperature insufficient to produce the change mentioned by Brande. Heat not only appears incapable of rendering the peroxide of iron magnetic without change of composition, but when already in that condition will entirely destroy it after long subjection to a high temperature. — *J. Robbins.*

Utilisation of Spent Bark of Tanneries. — Sir, — There is annually a vast quantity of spent bark, often mixed with valonea, (acorn cups from the Levant), thrown away from the tanneries of this and other countries; and many tanners are obliged, at a great expense, to erect kilns in which to burn it, not having kilns to stow it away. When completely decayed it resembles fine black mould, and is used by some farmers to cover manure heaps, as it absorbs the liquor and some of the ammonia.

Of course, it contains a large proportion of carbon, and probably humic and ulmic acid to a small extent. I should be very glad if any of your readers could inform me whether any experiments have been made to test its value. If any use could be found for this spent bark, &c. it would be a great advantage both to the discoverer and to the tanner.

Another thing wanted is an accurate method of testing the amount of tannin in vegetable substances, there being no practical method of doing so, the tanno-gelatin process having many objections. — *W. G. F.*

Conversion of Sulphate of Chromium into Bichromate of Potassa.—Sir, — In Balmain's process for obtaining oxygen by the reaction of concentrated sulphuric acid on bichromate of potassa, the chromic acid is reduced to the state of sesquioxide of chromium, which remains combined with SO_3 and KO.

How may it be economically reconverted into bichromate of potassa?—*E. G.*

MISCELLANEOUS.

Bitumenised Paper Tubing.—An experiment was recently made under the great clock tower, Westminister, for trying the strength, by hydraulic pressure, of a new description of tubing, composed of bitumenised paper, invented by M. Jaloureau, of Paris. M. Jaloureau is a contractor for paving Paris and other towns in France with bituminous concrete. It happened in the course of his experiments that some paper which had been coated with bitumen was laid aside in a coiled form, and after some time it became very stiff and solid. Pursuing the idea which thus accidentally occurred to him, M. Jaloureau put several layers of bitumenised paper round a cylinder, and submitting them to internal pressure, he found that a tube a quarter of an inch in thickness was capable of resisting a pressure of 250 lbs. to the square inch. The municipal authorities of Paris tried these tubes for the conveyance of gas, and in the recent experiments made here a piece of tube was produced, which, though stated to have been under ground in Paris as a gas pipe for twelve months, had the appearance of being a new pipe. The tubes subjected to the pressure of the hydraulic pump bore a strain of 250 lbs. to the square inch without bursting, which is more than they would be ever called on to bear in ordinary use. One of the tubes, half an inch thick, and with a bore of two inches, was also tested by weight, and it only gave way to a pressure of 428 lbs. the bearings being three feet apart. It was stated that the tubes might be submitted to a temperature of 160 degrees of Fahrenheit without any deterioration of the material. The cost of the tubing is said to be less than half that of the ordinary iron piping. Messrs. Paul Joske and Alexander Young are the patentees of the invention in this country.

Coating Electrotype Plates with Iron.—The following process has been successfully employed in coating electrotype deposits with a coating of pure iron; thereby rendering them little inferior to steel plate engravings as regards durability.

Dissolve 1 lb. of sal ammoniac in 1 gallon of rain water, then add 2 lbs. of neutral acetate of iron, boil the solution in an iron kettle for two hours, replacing the water lost by evaporation; when cold, filter the solution, and keep it in close covered vats (when not in use) to prevent oxidation.

The iron plate used in the decomposition cell must be of the same surface as the plate to be coated with iron; a Smee's battery of at least three cells, charged with 1 part sulphuric acid and 60 parts water being used for the decomposition.

To ensure success the following rules must be observed:—1st, The plate must be thoroughly freed from any greasy matter by immersing in a solution of caustic soda, then rinsed in clean cold rain water, after which dip it in dilute acetic acid, and immediately transfer it to the solution of iron; this will ensure perfect adhesion between the metals. 2nd, The solution must be filtered previous to use, to remove the oxyd of iron formed by exposure to the atmosphere. After the plates have been coated with iron they must be well rinsed in clear warm rain water, then in a weak alkaline solution, well dried with a piece of clean soft cotton, and slightly oiled to prevent oxidation.

The coating of iron is very hard and brittle, resembling the white iron used by manufacturers of malleable iron. Should any of the surface be damaged, the whole coating of iron may be removed by immersion in dilute sulphuric acid, and recoated again by the above process.—*Scientific American.*

Food and its Constituents.—Flesh-formers are indispensable to the very existence of the body, which is now believed to waste so fast that every 40 days we may be said to possess a new body. This is certainly fast living, compared with the slow ideas of the last generation of chemical physiologists, who estimated the time for such waste and renewal at seven years; but such is the modern idea, as we have stated, and perhaps the truth lies somewhere in the rather wide interval between forty days and seven years. But although flesh-forming food is thus indispensable, fuel-yielding food is no less indispensable, as the natural heat of the system is kept up by the latter, and not by the former. Fuel-yielding or heat-giving food must consist essentially of three of the four elements of flesh-yielding food, namely, carbon, hydrogen, and oxygen, the nitrogen not being essential to it as a heat-giver, though often still contained, to some extent, in heat-giving food; and indeed, neither is the oxygen of use as a heat-giver in the composition of the food, although it is essential as the evolver of heat when it combines, from the breathed air, with the elaborated heat-giving food of the blood, in the lungs; or burns that food as fuel, in so combining with its hydrogen and carbon, as to convert these into carbonic acid gas and watery vapour, which are sent up the windpipe by the expiratory act of breathing, and so expelled, like so much smoke from a furnace through a locomotive funnel or a chimney. The proximate elements or ingredients of heat-giving food are mainly starch, gum, sugar, and fat, each of these containing more or less of the three necessary elements. Thus fat, sugar, gum, and starch are of little or no use in building up the structure of the body, or in repairing its waste. The natural heat of the body is 98° Fah. This must be kept up by the heat-giving food—easy work for such food in tropical climes or in summer, but somewhat hard labour in the arctic regions, and in winter of the temperate climates. Among heat-giving food are potatoes, carrots, and other vegetables, rice, sugar, and the fat of animal food, the butter of milk, the oils of vegetables, &c. Five ounces of flesh-formers, being the amount required to restore the daily waste of the body, are contained in the quantities given of each of the following vegetable substances:—

	lbs.	oz.		lbs.	oz.
Wheat flour	2	1	Potatoes	20	12
Barley meal	2	6	Carrots	31	4
Oatmeal	1	13	Parsnips	15	10
Maize	2	9	Turnips	17	12
Rye	2	3	Cabbage	10	6
Rice	4	13	Tea (dry)	1	11
Buckwheat	3	10	Coffee (dry)	2	1
Lentils	1	3	Cocoa (nibs)	3	2
Peas (dry)	1	5	Bread	3	13
Beans (dry)	1	5			

To make Paper waterproof.—Dissolve 8 ounces of alum and 3½ ounces of white soap in 4 pints of water; in another vessel dissolve 2 ounces of gum arabic and 4 ounces of glue in 4 pints of water. Mix the two solutions and make the mixture hot. Immerse the paper in the mixture, and then hang it up to dry or pass it between cylinders.

The alum, soap, glue, and gum form a sort of artificial covering which protects the surface of the paper from the action of water, and to a certain extent from fire. This paper will be very useful for packages which may be exposed to the inclemency of the weather.—*Monitor de la Salud.*

ANSWERS TO CORRESPONDENTS.

R. T.—Consult *Ure's Dictionary.*

Yokels.—We cannot put our hand on the receipt just now, but will look again.

De Mouat.—1. All the processes for the preparation of aniline are long and complicated, and the description will occupy more space than we can give in this column. We hope to have an article on the subject soon. 2. It can only be procured direct from America. There is no publisher in London.

J. F. L. (Bury).—See above for aniline.

A Subscriber (Leeds).—1. Drop a little of the suspected spirit of nitre on filtering paper and allow it to evaporate spontaneously. If prepared with methylated spirit a smell of wood spirit will remain. 2. Artificial oil of almonds can be easily recognised alone. The real oil with strong nitric acid yields crystals of benzoic acid, which would not be obtained from the artificial oil. Perhaps the best way of detecting a mixture of real and artificial oil would be to treat an alcoholic solution with sulphuretted hydrogen and ammonia, and see if aniline could be separated.

G. H. (Wakefield).—1. If we saw the results we could better advise our correspondent. 2. Most likely after some time.

M. S. C.—1. To make butyric ether; butter is saponified with a strong solution of potash, the soap is dissolved in the smallest possible quantity of hot strong alcohol; a mixture of alcohol and oil of vitriol is added to the solution until it acquires a strong acid reaction, and the whole is distilled until the distillate no longer smells of apples. It is then rectified by redistillation with chloride of calcium. 2. Ozone cannot be made cheaply in any quantity.

S. Q. L.—Try annatto.

J. C. B.—An earthenware retort can be procured at the Lambeth potteries.

A Subscriber (Northampton).—We have to thank this and numerous correspondents for various suggestions. Our wish is to please all, but we have no desire to realise the fable of the old man and his ass.

P. McO.—No doubt the last opinion is the result of Deville's latest experiments. His process will soon be in use in England, and we shall have an opportunity of testing the truth of the statement.

Aonides.—Consult Knapp's *Technology*, last edition by Ronalds and Richardson.

Inops—*T. S.*—received too late for insertion this week.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London E. C.

THE CHEMICAL NEWS.

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THE ADULTERATION OF FOOD BILL.

GUY-PATIN, in a letter dated March 2, 1655, writes in terms of strong condemnation of the *opera medico-chymica* of Paracelsus, which it was proposed to reprint, and says of chemistry: "La chimie est la fausse monnaie de notre métier. Je voudrais que, pour le bien public, elle fût aussi bien défendue que les faux quart d'écus pour lesquels on a autrefois pendu tant de faux-monnoyeurs." The celebrated physician, when he wrote in such contemptuous language of chemistry, had not the faintest conception of the important position it was destined to attain among the sciences, any more than he could foresee the inestimable benefits which mankind at large have derived from it. There is, however, one direction in which chemical knowledge has been extensively applied for the injury and seldom for the good of individuals, viz. in the adulteration of articles of food. Thus, by its agency bad wine is made to assume the appearance of good; essences of fruit are manufactured into the composition of which fruit never entered; bad flour is converted into the best bread, and we might mention a host of substances which chemistry is employed to adulterate in some way or other, to the wrong of the consumer and the demoralisation of the vendor. Learned and thoughtful physicians, who have well-considered the question, have arrived at the conclusion that a great proportion of the diseases of the digestive organs arise from this universal adulteration of articles of food, and it has therefore become a matter of grave national importance that the legislature should take some steps to put an end to this abominable perversion of scientific knowledge. With this object Mr. Scholefield, assisted by Mr. Wise and Mr. Villiers, has drawn up a bill imposing a penalty on persons guilty of adulterating articles of food or drink. It proposes that any person who shall knowingly sell an article of food or drink with which any noxious substance has been mixed, or who shall sell as pure and unadulterated any article of food or drink which is not pure, shall on conviction before two justices of the peace be fined and made to pay the costs, and in the event of a second conviction the justices shall have power to cause the offender's name and offence to be published in such a manner as they may think advisable. To prevent adulteration by the purchaser the justices must be satisfied that he gave notice to the seller of his intention to have the article analysed, so as to give him an opportunity of seeing it placed in the hands of the analyst. Vestries and district boards in London and town councils in boroughs are to have the power of appointing persons possessing competent medical, chemical, and microscopical knowledge as analysts, and allow them such office and salaries for analysing food and drink as they may think fit. These analysts are to be bound to analyse any articles of food or drink which purchasers may bring to them for a fee ranging from half-a-crown to half-a-guinea, and to give a certificate stating whether it is adulterated, and, if so, whether the foreign substance is injurious to health; and this certificate, in the absence of any evidence to the contrary, shall be received as evidence by the justices, and the cost of the certificate included with the costs attending a conviction. The justices are to have power to cause any article of food or drink to be analysed by any person they may think proper to appoint, who may be required to give evidence at the hearing of the case, the whole of the costs to be borne by the complainant or defendant, as the justices shall determine. Persons convicted before the justices are to be allowed an appeal to quarter sessions. The penalties to be inflicted under this act to be paid to the vestry, district board, or town council, to be disposed of for parish purposes. The expenses attending the carrying out of this act to be defrayed, in the metropolis, out of the fund applicable to the purposes of the metropolitan management act, and in boroughs out of the borough fund. Under the term articles of food is included all alimentary substances not taken as medicine. The addition of water to spirits to reduce the strength is not to be considered as adulteration.

That this bill as it stands will become law we think neither probable nor desirable, but the necessity of such legislation once admitted by Parliament it will be easy to modify it so as to make it more effectual for carrying out the object proposed. In the very first clause there is a stumbling block to the conviction of offenders. It says that the vendor must be cognisant of the adulteration. Now, suppose he says that he was ignorant of the article being adulterated, how will the justices proceed in that case? This will have to be amended, and the law must assume that the vendor of adulterated articles is guilty of the adulteration. The motive for allowing the vendor this loophole of escape is, doubtless, to save him from becoming the victim of the wholesale dealer, but this is unnecessary; the wholesale dealer will cease to adulterate when he knows that the conviction of his customer will inevitably lead to his own exposure and consequent loss of custom. If this is not sufficient, a clause might be inserted giving the convicted retail dealer the power of suing the wholesale dealer for the costs incurred by him in the matter.

Another weak point in the bill is, it appears to us, the power of appeal which it gives to persons convicted. This can only tend to deter public spirited persons from prosecuting adulterators, and does not appear to be of use to protect honest tradesmen, as the evidence on which the conviction is founded in one court will be the same in the other, and as it will rest on a matter of fact no amount of argument can alter it.

Let us suppose that a Paterfamilias, honestly indignant at finding that his coffee is largely adulterated with chicory and dried coffee grounds, or that his milk is a compound mixture, determines on punishing the fraudulent tradesman, and succeeds in getting him fined; Paterfamilias is satisfied, and retires from the court with

that gratifying conviction that he deserves well of his country, which is the reward of prosecutors of abusive or extortionate cabmen; but is the tradesman satisfied? Not at all! He gives notice of appeal, and Paterfamilias has either to attend at the sessions personally or by his agent, or let the thing take its course, and in the event of the conviction being quashed, risking a considerable amount of obloquy for having maliciously attempted to ruin an innocent individual, to say nothing of the possibility of his being forced to pay the costs.

The bill also seems to leave too much to the option of persons who are not likely to be over anxious to carry out its provisions very strictly. It is not sufficient to say that vestries and boards *may* appoint analysts; the imperative mood should be used, and it should be made compulsory on these officials to appoint them, who should, moreover, be obliged to be reasonably active in purchasing articles of food and drink and testing their purity. No mention of this is made in the bill, and for aught that appears to the contrary, the analyst, even if appointed, may sit at ease in his office and wait for individuals to bring him work to do; since it does not appear probable that parish officials, who are themselves for the most part tradesmen, will insist on his being very energetic in the performance of his duties. The enforcement of the bill, if it becomes law, will rest entirely with these parish officials, who may decline to appoint an analyst at all; and even if they are moved by public opinion to do this much they may refuse to order a prosecution, and we all know how certain it would be to become a dead letter if it were left to the public to enforce its provisions. We conceive, therefore, that to make the bill effective its provisions must be made more stringent; and we think that instead of paying the analyst a salary, it would tend more to the effectual carrying out of the object which the promoters of the bill have in view if he were to receive a certain proportion of the fine.

With regard to the punishment to be inflicted on convicted adulterators, we think it might be made heavier than is proposed by the bill. The infliction of a penalty merely would be inadequate to check the system of adulteration, but when to this exposure is added there is good hope that it may be brought to an end. The only question to be considered is the manner of the exposure. To publish the conviction in a newspaper would be useless in the majority of cases, and we therefore think it would be well to adopt the practice pursued in France. On a second conviction let the name of the dishonest vendor, the nature of his offence, and its punishment be published in the *Gazette*, from which the newspapers would be pretty certain to quote it, and a report of it printed and nailed to his own door-post; the whole to be done at his expense. The last method of exposure is the only one in which we place any confidence, for in poor neighbourhoods, where the inhabitants suffer most, a tradesman might be fined a dozen times without his customers becoming aware of it; but if a printed report of the case stared them in the face when they were about to enter the shop it would be a sufficient warning to them to go elsewhere. The number of days during which he should be compelled to expose the placard might be proportioned to the enormity of his offence.

To sum up the amendments we think necessary to make the bill effective: Let the vendor of adulterated articles be assumed to be the adulterator, giving him, if innocent, the remedy we have suggested. Make it compulsory on vestries, &c. to appoint one or more analysts in their respective parishes. Make it obligatory on analysts to purchase and analyse a minimum number of of samples of food and drink each week. Let the exposure on a second conviction be that we have indicated, and let it be prescribed by the law, and not left to the discretion of the justices.

If the bill, amended in the manner we have suggested becomes law, a tradesman will hesitate before yielding to the temptation to increase his profits by defrauding his customers, especially when a few convictions have taught him that there is no kind of adulteration which it is not in the power of chemists to detect.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Phosphoric Acid in Manures, Coprolites, Bone-ash, and similar Commercial Substances, by FRANCIS SUTTON, *Norwich.*

[SECOND PART.]

WHEN a compound containing iron as well as phosphoric acid is submitted to analysis by the uranium process described in the first part of this article, the precipitate of phosphate of uranium invariably carries down a portion of iron with it. In this case the colour of the precipitate is altered to a dirty orange-yellow, and possesses a somewhat granular appearance. The quantity of iron depends in some measure upon the length of time the mixture has been kept at a boiling heat. Arendt and Knop found that the fresh precipitate contained about 0·5 per cent. as the following numbers will show:—

Ur_2O_3	78·80
Fe_2O_3	0·46
PO_5	20·65
	99·91

If the boiling be continued for about twenty minutes, the iron is entirely removed from the precipitate, and the solution is coloured red by acetate of sesquioxide of iron. The better way, however, is, not to depend upon this mode of separation, but to use the modification suggested by Arendt and Knop; that is, to reduce the sesquioxide of iron to protoxide, by means of protochloride of uranium.

It may not be amiss here to give the best method of preparing a solution of protochloride of uranium, which promises to be a most serviceable reducing agent in analysis.

Ammonio-carbonate of uranium is to be dissolved in about twice as much hydrochloric acid (diluted with an equal quantity of water) as is necessary for solution. A concentrated solution of bichloride of platinum added in the proportion of about two drops to each ounce of uranium-salt; fine shreds of copper are then to be added in excess, and the mixture boiled for ten or fifteen minutes, or until the liquid assumes a distinct green colour, and the sesquichloride of uranium is reduced to protochloride.

In order to remove the protochloride of copper from the solution it is now to be boiled until, on adding a few drops to some water, an immediate precipitate is produced. Half an hour's boiling is generally sufficient to attain this end. The solution is then to be diluted pretty freely with water, and set aside to cool. When perfectly cold, the copper will in great measure be separated. Hydrosulphuric acid, however, must be passed through the filtered solution till every trace of copper is precipitated and the liquid smells strongly of the acid.

The filtered liquid is now to be poured into a porcelain capsule, and evaporated at a boiling heat, adding some considerable quantity of chloride of ammonium to prevent the precipitation of protoxide and sulphide of uranium, which would otherwise be the case.

As the hydrosulphuric acid is very difficult to remove, the evaporation must be carried on till the liquid corresponding to each ounce of the original uranium salt is reduced to about three ounces. It is absolutely necessary that every trace be removed—if at the end of the operation a precipitate has occurred—it may be dissolved in a little concentrated hydrochloric acid after the clear green liquid has been poured off, and the two solutions mixed and kept for use.

The solution so prepared contains chloride of ammonium, which is of no consequence for the purpose here contemplated; neither is it any hindrance to the preparation of the pure crystals of protochloride of uranium, as on adding excess of ammonia the uranium is precipitated and can be redissolved.

The value of this solution as a means of reducing sesquioxide to protoxide of iron (and probably other higher oxides to lower) cannot be too highly estimated, for at ordinary temperatures it takes place speedily, but at boiling heat, immediately: moreover the change is visible to the eye, for the reddish colour of the solution gives place to green, and so long as this is the case the iron exists in the form of protoxide.

The delicacy of this reaction may be readily seen, if to a solution of sesquichloride of iron a drop or two of sulphocyanide of potassium be added, which produces a blood-red colour: add now a few drops of the uranium solution, and immediately the colour turns to green, showing that a reduction has taken place: this reaction may be made over and over again by adding first iron and then uranium.

To return, however, to the practical bearing of this circumstance upon the separation of phosphoric acid and iron, the following course must be adopted:—

The compound is to be dissolved in the smallest possible quantity of hydrochloric acid (at most 1½ ounce) and the solution of protochloride of uranium added in sufficient quantity to produce a distinct green colour, or until one drop of sulphocyanide of potassium does not show a change to red. Now add ammonia in sufficient quantity to neutralise the free hydrochloric acid, making sure by throwing into the mixture a small piece of litmus paper. Add a solution of acetate of uranium and free acetic acid, together with a few drops of acetate of protoxide of uranium (obtained by precipitating the protochloride with ammonia and redissolving in warm acetic acid), to insure the presence of sufficient protoxide, and heat to boiling.

The mixture must now possess a distinct greenish colour, not a dirty tinge, which shows the presence of undissolved protoxide of uranium. Put aside until the precipitate has settled; when this has *completely* taken place decant the supernatant liquid through the filter; pour hot water over the precipitate, adding some chloride of ammonium, and boil again; repeat the operation once more and the washing is complete: the precipitate may now be thrown upon the filter, dried, and burned as described in the first part of this paper.

I had intended to give the result of some experiments on the separation of phosphoric acid from alumina by means of uranium, but have not been able to complete them satisfactorily. In a future number probably I may be able to do so.

TECHNICAL CHEMISTRY.

Influence of different kinds of Manure on Herbage.

The grasses form a most important tribe of farm plants. Nutritious in their bulky green state, and highly conducive to the health of the stock which browse upon them in our pasture fields, they are no less valuable when dried into hay. The natural history of the grasses has long since been written; they are belonging to one great family of plants — the graminaceous — and possess certain characteristic properties by which we readily recognise them. The chemical and other properties of the grasses vary very considerably. One contains more albuminous compounds; another more mineral ingredients; one is most nutritive at the period of flowering; another contains most nutritive matters when fully matured. It is, however, singular that we are not in possession of reliable data whereby to pronounce an opinion as to the relative merits of the grasses. Science has thrown some light upon this subject; it is but that dim glimmer which prevents our seeing the entire distance before us. There is a dark place which must be illumined, and an ignorance which must be corrected, ere the farmer and the grazier can truly balance the merits and demerits of particular grasses for particular purposes. Chemical analysis alone will not accomplish all that we require, any more than the empiric conjecture of the more practical man; the two must co-operate, and naturally correct and assist each other.

The grasses, like other plants, are amenable to those various physical agencies which influence vegetable life. Heat, air and light exercise their own distinctive functions in modifying the size, &c. of plants. That there is a most intimate connection too between the soil and the character of the vegetation which it naturally bears is well known. It is also a well-known fact that the manures with which we top-dress grass lands very considerably influence the character of the sward, diminishing the proportion of one species of grass and increasing that of another. The laws by which these modifications were effected remained unknown, however, until Messrs. Lawes and Gilbert undertook to investigate the subject. In experiments instituted to test the effects of different manures in simply increasing the valuable yield of grass, they were so struck with the marked effects of some of the manures in destroying certain plants and families of plants that they sought the assistance of the late Professor Henfrey in classifying the plants composing the sward. The plots selected for botanical examination were:—

1. Not manured.
2. Manured with ammoniacal salts alone.
3. „ mixed mineral manures alone.
4. „ do. and ammoniacal salts.
5. „ do. and double quantity of do.
6. „ farm-yard manure.
7. „ do. and ammoniacal salts.

The herbage was classified chiefly into (*a*) graminaceous plants, (*b*) leguminous plants, and (*c*) miscellaneous herbage, principally weeds.

The graminaceous plants formed, at the time of cutting, 75 per cent. of the produce of the unmanured portion; on the part manured with farm-yard manure, they found 87¾ per cent.; 79¾ per cent. when farm-yard manure and ammoniacal salts were used: 72 per cent. on the portion to which mineral manures were applied; 89 per cent. where 40 lbs. of ammoniacal salts alone were used; 79½ per cent. by the same amount of ammoniacal salts and mineral manure; and 97¾ per cent. where the

double allowance of both ammoniacal salts and mineral manures were applied. The quality of the graminaceous herbage varies no less than the proportion of it which composed the herbage under the different manures.

At one time the graminaceous portion of the herbage consisted of 66 per cent. of flowering or seeding stem, and 34 per cent. of leaf and undeveloped stem, on the unmanured plot; 59 per cent. of flowering and seeding stem by mineral manure alone; 40 per cent of the same by ammoniacal salts only; 75 per cent. by the joint application of animal and mineral manures; 67 per cent. by double application of both manures; and 80 per cent. when farm-yard manure and ammoniacal salts were applied.

It has been found that the manures which increase the amount of whole produce also increase, in a very high degree, the proportion of graminaceous herbage, a conclusion which is of no less interest than importance. The foregoing facts also lead to another instructive conclusion, namely, that nitrogenous manures have a special effect in developing the "proportion of leaves and shoots," while mineral manures tend to the increase of the flowering and seeding of the plants; a conclusion of great practical value to the farmer, as it teaches that guano and sulphate of ammonia produce very different results from those mineral manures which depend for their efficacy on their containing the ash constituents of plants. — *Irish Agricultural Review.*

PHARMACY, TOXICOLOGY, &c.

On the Preparation of Ecbaline, the active principle of Ecbalium Officinarum, by JOHN WILLIAMS.

THE *Ecbalium officinarum* (*Momordica elaterium*), or squirting cucumber, appears to have been employed as a purgative from the time of Dioscorides and Pliny, or possibly much earlier: and the so-called extract is the form in which it has usually been administered.

This *extract* is, as is well known to pharmaceutists, produced by a process totally different from that employed for the production of an ordinary extract.

The cucumber is sliced longitudinally, and subjected afterwards to gentle pressure, the juice thus obtained being allowed to remain at rest for ten or twelve hours, by which time a greenish feculent matter will have deposited. The clear supernatant liquor being rejected, the deposited matter is drained on a linen cloth, and afterwards dried at a very gentle heat, and thus we obtain the thin flaky pieces met with in commerce. As may be supposed, this extract is liable to very great discrepancies in strength and quality; for if the pressure used is great, a large percentage of inert matter will be expelled from the cucumbers, and thus the activity of the medicine will be reduced to an important extent.

The quantity of fine extract of elaterium which can be obtained is stated[1] to be about 3 drs. from 1 bushel of the fruit, weighing in the fresh state 40 lbs. Other authorities give quantities varying from 2 drs. to 4 drs., or even more, doubtless dependent upon the amount of pressure and washing the cucumbers were submitted to, and also the length of time the fluid was allowed to stand before the deposited matter was separated.

The activity of the extract of elaterium depends upon a white crystallisable body to which the name *elaterin* was formerly given, but for which the title *ecbaline* is proposed to be substituted. Pereira points out that the quantity of this principle contained in various samples of the extract of commerce varied from 44 per cent. to 33, 26, 15, and in a foreign article it may be found as low as 5 or 6 per cent. From an experiment of his own upon some extract very carefully prepared at Apothecaries' Hall, he concluded that 30 grs. yielded 7·5 grs. or 25 per cent.; and in a trial I have just made, 3 drs. of extract, purchased as the finest commercial article (taken as being probably equivalent to 1 bushel or 40 lbs. of the wild cucumbers), yielded me exactly 36 grs. of white crystallised ecbaline, equivalent to only 20 per cent.

Of course discrepancies like these are much to be deplored in medical practice, and if the active principle only was used in medicine, much greater certainty of effect would doubtless attend the administration of the remedy. The objection to the use of the ecbaline, however, has hitherto been the high cost of producing the article, thus rendering it almost impossible to employ the remedy in any but experimental trials. With a view of removing this obstacle, Dr. R. B. Garrod, one of the committee at present engaged in drawing up the new British Pharmacopœia, suggested that probably other portions of the fruit as well as the juice would, if properly treated, yield a large quantity of the active principle, and proposed to Messrs. Savory and Sons, and afterwards to our firm, that we should experimentally test the feasibility of his process. Upon consulting together, it was determined that the operations should be conducted in our laboratory, and I have now the pleasure of laying the results of our inquiries before the profession.

Dr. Garrod's proposed process for the production of the ecbaline was as follows:— The cucumbers are to be sliced and dried at a gentle heat, but so that no loss of juice shall occur. The dried fruits to be treated with alcohol, and the alcoholic extract thus obtained acted upon with solution of potash, in which the starch, green colouring matter, &c. is soluble, but in which the ecbaline is not only insoluble, but remains perfectly unaffected by the powerful reagent employed. The residuum therefore, dissolved in alcohol and crystallised, will of course give the ecbaline in a state easily rendered quite pure by a subsequent solution in alcohol, digestion with animal charcoal, and re-crystallisation.

It appeared reasonable that by this process *all* the ecbaline contained in the cucumbers would be extracted, whereas by the ordinary process of making the extract, it may be supposed some, or even a large quantity of active principle, may be left in the plant.

One bushel (weighing 40 lbs. in the fresh state) of wild cucumbers was operated upon. They were carefully sliced longitudinally upon an inclined slab, so that any juice yielded during the operation would flow into a vessel placed for its reception. The cut cucumbers were then placed on a seive for 12 hours (but were not pressed in any way), and then placed in earthen pans, in a warm closet, where in the space of 4 days they became completely dry. In this state they weighed 3lbs.

[1] *Pharmaceutical Journal*, vol. i. New Series, p. 325.

5oz. The liquor which had drained from the cucumbers during the cutting and draining was evaporated to dryness by itself at a gentle heat, and yielded 3oz. extract: this we will call extract No. 1.

The dried cucumbers were now placed in a digesting apparatus, with 2 gallons of alcohol, and the temperature was raised to the boiling point. Afterwards they were allowed to digest for 24 hours. Then the tincture was drained and the operation repeated with another 2 gallons of alcohol. The mixed tinctures when filtered, presented a bright green colour, and being placed in a still the alcohol was drawn over. A small quantity of green extract was the result: this extract we will call No. 2.

The extract No. 1 (the evaporated juice) was treated with successive portions of boiling alcohol, until nothing more could be extracted; the filtered tinctures evaporated to dryness, gave a small quantity of greenish extract. This greenish extract was then treated with about 8 times its bulk of hot liquor potassæ. After digesting for a short time, the greater portion of the matter dissolved, leaving, however, when filtered, washed, and dried, 30 grains of nearly white crystalline matter, which proved to be the ecbaline we were in search of.

Extract No. 1 was treated in a like manner, and yielded 57 grains of matter, insoluble in liquor potassæ, but of a dark greenish-brown colour. Both these deposits were then dissolved in boiling alcohol, a very small quantity of pure animal charcoal added, filtered, and allowed to crystallise.

The matter from extract No. 1 yielded 28½ grs. of ecbaline, white and crystallised. The matter, however, from No 2 extract refused to yield crystals, and gave only a dark coloured fatty mass, which after another trial at crystallisation yielded no better result. It was then attempted to dissolve the fatty matter from any ecbaline which might be present by means of a small quantity of cold ether, but no good effect was produced, the whole mass dissolving freely in that menstruum, whereas ecbaline is but slightly soluble in it.

The result of this experiment appeared so unsatisfactory and so different from what was anticipated, that I determined to repeat the experiment, though in a rather different manner.

One bushel of wild cucumbers was again taken. They were cut up with the same precautions as before, catching all the juice carefully; then well bruised in a large mortar, the mass placed upon sieves and allowed to drain. They were then stirred up with about their own bulk of cold water, allowed to drain, and then subjected to strong pressure through very coarse canvas. By this means a considerable amount of juice was obtained, which upon standing separated into three portions —an insoluble green deposit (the extract of elaterium), and a large quantity of coagulated chlorophyll, floating in a clear aqueous liquid. The whole was thrown upon a calico filter, and the solid matter, after being well drained from the liquid portion, dried between chalk stones. When dry it weighed 2½oz. The aqueous portion was evaporated to the consistence of an extract.

The mass of the cucumbers, after the juice had been thus pressed out, was dried as in the first experiment, digested in boiling alcohol twice, and the mixed tinctures strained and distilled. The amount of extract yielded, was, as might be expected, much smaller in quantity than on the previous occasion.

First, the solid matter which had been strained from the juice (which I look upon as equivalent to the ordinary extract of elaterium, though not in so pure or concentrated a form) was treated with successive portions of boiling alcohol until nothing more would dissolve, and the mixed tinctures evaporated to dryness. This we will call extract No. 1.

Then the extract produced by evaporating the aqueous liquor was treated with alcohol, and yielded a small quantity of brown extract, which we will call No. 2.

The thin alcoholic solution of the cucumber-mass, upon standing, separated into two portions. The more liquid portion was evaporated by itself to dryness: this constitutes No. 3, the solid portion of the alcoholic extract of the mass No. 4.

These several extracts were then treated with hot liq. potassæ, and allowed to digest for some hours, then, somewhat diluted, were filtered, washed and dried.

The dried precipitates were treated with boiling alcohol and filtered, and the alcohol allowed to evaporate gave the following results:

No. 1 extract yielded 25 grains of nearly white crystallised ecbaline;

No. 2, 38 grs. of dark brown non-crystalline mass, which appeared to possess none of the properties of ecbaline;

No. 3 yielded 10 grains of a much lighter and crystalline mass, which probably by further purification will yield a few grains of ecbaline;

No. 4 yielded 14 grains of green waxy matter.

The chlorophyll and residual matter which had refused to dissolve in the boiling alcohol to form extract No. 1 was treated with liq. potassæ, by which means a large portion was dissolved, and that which remained behind was again boiled in alcohol; but the result was only a few grains of brown extractive matter quite free from ecbaline.

The conclusion which must be drawn from these experiments is, I think, that the mass of the cucumber after separation of the juice contains so small a quantity of ecbaline that the loss of alcohol and working expenses would not be covered by the value of the substance produced: that the only portion which yields ecbaline is the insoluble deposit from the juice, which we already know under the name of extract of elaterium, this substance yielding the ecbaline with ease: and that the aqueous portion of the juice is perfectly worthless for the purpose.

Thus we find that the quantity of ecbaline yielded by the large bulk of one bushel of cucumbers is only at most 30 grains, and as the labour and expense attendant upon the operation is considerable, it must be evident that the substance must remain a very expensive one to manufacture; and I am inclined to think it very probable that ecbaline can be made (at any rate in London) at a cheaper rate from ext. elaterium itself than direct from the cucumbers.

I may add in conclusion that through Messrs. Savory and Sons I have been able to operate upon some German extract of elaterium. This extract is in appearance similar to ordinary extract of henbane, or liquorice, and is evidently obtained from the plant itself, and was sold as low as 10s. 6d. per lb. It was imagined that this extract might be a cheap source for the production of the ecbaline. One ounce of it was digested with boiling alcohol and the alcoholic extract prepared, which was then treated with the solution of caustic potash in the same manner as the other extract; but I have been unable to obtain even the slightest trace of crystalline matter from it. It would be interesting to know whether the extract itself has *any* cathartic action.

5 New Cavendish Street

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Six Lectures [1] *(adapted to a Juvenile Auditory), consisting of Illustrations of the Various Forces of Matter, i. e. of such as are called the Physical or Inorganic Forces — including an Account of their Relations to each other; by* M. FARADAY, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R. I., Foreign Associate of the Academy of Sciences, Paris, &c.*

LECTURE VI. (Jan. 7, 1860.) *The Correlation of the Physical Forces.*

We have frequently seen during the course of these lectures, that one of those powers or forces of matter of which I have written the names on that board, has produced results which are due to the action of some other force. Thus, you have seen the force of electricity acting in other ways than in attracting; you have also seen it combine matters together or disunite them by means of its action on the chemical force; and in this case, therefore, you have an instance in which these two powers are related. But we have other and deeper relations than these; we have not merely to see how it is that one power affects another—how the force of heat affects chemical affinity, and so forth, but we must try and comprehend what relation they bear to each other, and how these powers may be changed one into the other; and it will to-day require all my care, and your care too, to make this clear to your minds. I shall be obliged to confine myself to one or two instances, because to take in the whole extent of this mutual relation and conversion of forces would surpass the human intellect.

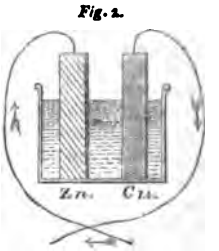
In the first place, then, here is a piece of fine zinc-foil, and if I cut it into narrow strips and apply the power of heat to it, admitting the contact of air at the same time, you will find that it burns; and then, seeing that it burns, you will be prepared to say that there is chemical action taking place. You see all I have to do is to hold the piece of zinc at the side of the flame so as to let it get heated, and yet to allow the air which is flowing in to the flame from all sides to have access to it;—there is the piece of zinc burning just like a piece of wood, only brighter. A part of the zinc is going up into the air in the form of that white smoke, and part is falling down on to the table. This then is the action of chemical affinity exerted between the zinc and the oxygen of the air. I will show you what a curious kind of affinity this is by an experiment which is rather striking when seen for the first time. I have here some iron filings and gunpowder, and will mix them carefully together with as little rough handling as possible; now we will compare the combustibility so to speak of the two. I will pour some spirit of wine into a basin and set it on fire: and having our flame, I will drop this mixture of iron filings and gunpowder through it, so that both sets of particles will have an equal chance of burning. And now tell me which of them it is that burns?—you see a plentiful combustion of the iron filings; but I want you to observe that though they have equal chances of burning, we shall find that by far the greater part of the gunpowder remains untouched: I have only to drain off this spirit of wine and let the powder which has gone through the flame dry, which it will do in a few minutes, and I will then test it with a lighted match. So ready is the iron to burn, that it takes, under certain circumstances, even less time to catch fire than gunpowder. [As soon as the gunpowder was dry Mr. Anderson handed it to the Lecturer, who applied a lighted match to it, when the sudden flash showed how large a proportion of gunpowder had escaped combustion when falling through the flame of alcohol.]

These are all cases of chemical affinity, and I show them to make you understand that we are about to enter upon the consideration of a strange kind of chemical affinity, and then to see how far we are enabled to convert this force of affinity into electricity or magnetism, or any other of the forces which we have discussed. Here is some zinc (I keep to the metal zinc as it is very useful for our purpose), and I can produce hydrogen gas by putting the zinc and sulphuric acid together as they are in that retort; there you see the mixture which gives us hydrogen —the zinc is pulling the water to pieces and setting free hydrogen gas. Now we have learned by experience that if a little mercury is spread over that zinc, it does not *take away* its power of decomposing the water, but *modifies* it most curiously. See how that mixture is now boiling, but when I add a little mercury to it the gas ceases to come off. We have now scarcely a bubble of hydrogen set free, so that the action is suspended for the time. We have not *destroyed* the power of chemical affinity, but modified it in a wonderful and beautiful manner. Here are some pieces of zinc covered with mercury exactly in the same way as the zinc in that retort is covered, and if I put this plate into sulphuric acid I get no gas, but this most extraordinary thing occurs, that if I introduce along with the zinc another metal which is *not* so combustible, then I reproduce all the action. I am now going to put to the amalgamated zinc in this retort some portions of copper wire (copper not being so combustible a metal as the zinc) and observe how I get hydrogen again, as in the first instance—there, the bubbles are coming over through the pneumatic trough, and ascending faster and faster in the jar; the zinc, so to speak, is acting by reason of its contact with the copper.

Every step we now take brings us to a knowledge of new phenomena. That hydrogen which you now see coming off so abundantly does not come from the zinc as it did before, *but from the copper*. Here is a jar containing a solution of copper. If I put a piece of this amalgamated zinc in it, and leave it there, it has hardly any action, and here is a plate of platinum which I will immerse in the same solution, and might leave it there for hours, days, months, or even years, and no action would take place. But now I put them both in together, and let them touch each other. (*fig.* 1.) See what a coating of copper there is immediately thrown down on the platinum. Why is this? The platinum has no power of itself to reduce the metal from that fluid, but it has in some mysterious way received this power by its contact with the metal zinc. Here then you see a strange transfer of chemical force from one metal to another — the chemical force from the zinc is transferred, and made over to the platinum by the mere association of the two metals. I might take instead of the platinum, a piece of copper or silver, and it would have no action of its own on this solution, but the moment the zinc was introduced and touched to the other metal, then the action would take place, and it would become covered with copper. Now, is not this most wonderful and beautiful to see? we still have the identical chemical force of the particles of zinc acting, and yet in some strange manner we have power to make that chemical force, or something it produces, travel from one place to another,—for we do make the chemical force travel from the zinc to the platinum by this very curious experiment of using the two metals in the same fluid in contact with each other.

Fig. 1.

Fig. 2.



Let us now examine these phenomena a little more closely. Here is a drawing (*fig.* 2.) in which I have represented a vessel containing the acid liquid and the slips of zinc and platinum or copper, and I have shown them touching each other *outside* by means of a wire coming from each of them (for it matters not whether they touch in the fluid or outside—by pieces of metal attached they still by that communication between them, have this power transferred from one to the other). Now, if instead of using only one vessel, as I have shown there, I take another, and another, and put in zinc and platinum, zinc and platinum, zinc and platinum, and connect the platinum of one vessel with the zinc of another, the platinum of this vessel with the zinc of that, and so on, we should only be using a series of these vessels instead of one. This we have done in that arrangement which you see behind me. I am using what we call a Grove's voltaic battery, in which one metal is zinc, and the other platinum, and I have as many as forty pairs of these plates all exercising their force at once in sending the whole amount of chemical power there evolved through these wires under the floor and up to these two rods coming through the table. We need do no more than just bring these two ends in contact, when the spark shows us what power is present; and what a strange thing it is to see that this force is brought away from the battery behind me, and carried along through these wires. I have here an apparatus (*fig.* 3.) which Sir Humphry Davy constructed many years ago, in order to see whether this power from the

[1] Reported verbatim by special permission.

voltaic battery caused bodies to attract each other in the same manner as the ordinary electricity did. He made it in order to experiment with his large voltaic battery, which was the most powerful then in existence. You see there are in this glass jar two leaves of gold, which I can cause to move to and fro by this rack work. I will connect each of these gold leaves with separate ends of this battery, and if I have a sufficient number of plates in the battery I shall be able to show you that there will be some attraction between those leaves even before they come in contact: if I bring them sufficiently near when they are in communication with the ends of the battery, they will be drawn gently together, and you will know when this takes place, because the power will cause the gold leaves to burn away, which they could only do when they touched each other. Now I am going to cause these two leaves of gold to approach gradually, and I have no doubt that some of you will see that they approach before they burn, and those who are too far off to see them approach will see by their burning that they have come together. Now they are attracting each other, long before the connection is complete, and there they go! burnt up in that brilliant flash, so strong is the force. You thus see, from the attractive force at the two ends of this battery, that these are really and truly electrical phenomena.

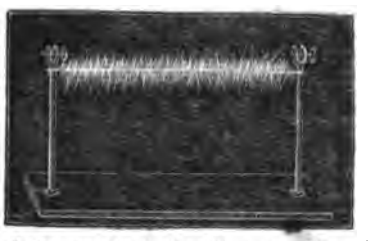
Fig. 3.

Fig. 4.

Now let us consider what is this spark. I take these two ends and bring them together, and there I get this glorious spark like the sunlight in the heavens above us. What is this? It is the same thing which you saw when I discharged the large electrical machine, when you saw one single bright flash; it is the same thing, only *continued*, because here we have a more effective arrangement. Instead of having a machine which we are obliged to turn for a long time together, we have here a *chemical* power which sends forth the spark — and it is wonderful and beautiful to see how this spark is carried about through these wires. I want you to perceive, if possible, that this very spark and the heat it produces (for there is heat), is neither more nor less than the chemical force of the zinc—its *very* force carried along wires and conveyed to this place. I am about to take a portion of the zinc and burn it in oxygen gas for the sake of showing you the kind of light produced by the actual combustion in oxygen gas of some of this metal. [A tassel of zinc-foil was ignited at a spirit-lamp and introduced into a jar of oxygen, when it burnt with a brilliant light.] That shows you what the affinity is when we come to consider it in its energy and power. And the zinc is being burned in the battery behind me at a much more rapid rate than you see in that jar, because the zinc is there dissolving and *burning*, and produces here this great electric light. That very same power which in that jar you saw evolved from the actual combustion of the zinc in oxygen is carried along these wires and made evident here, and you may if you please consider that the zinc is burning in those cells, and that *this* is the light of that burning [bringing the two poles in contact and showing the electric light]; and we might so arrange our apparatus as to show that the amounts of power evolved in either case are identical. Having thus obtained power over the chemical force, how wonderfully we are able to convey it from place to place; when we use gunpowder for explosive purposes, we can send into the mine chemical affinity by means of this electricity; not having provided fire beforehand, we can send it in at the moment we require it. Now here (*fig.* 4.) is a vessel containing two charcoal points, and I bring it forward as an illustration of the wonderful power of conveying this force from place to place. I have merely to connect these by means of wires to the opposite ends of the battery, and bring the points in contact. See! what an exhibition of force we have. We have exhausted the air so that the charcoal cannot burn, and therefore the light you see is really the burning of the zinc in the cells behind me—there is no disappearance of the carbon, although we have that glorious electric light; and the moment I cut off the connection it stops. Here is a better instance to enable some of you to see the certainty with which we can convey this force where under ordinary circumstances chemical affinity would not act. We may absolutely take these two charcoal poles down under water, and get our electric light there;— there they are in the water, and you observe when I bring them into connexion we have the same light as we had in that glass vessel.

Now besides this production of light we have all the other effects and powers of burning zinc. I have a few wires here which are not combustible, and I am going to take one of them, a small platinum wire, and suspend it between these two rods which are connected with the battery, and when contact is made at the battery see what heat we get. (*fig.* 5.) Is not that

Fig. 5.



beautiful?—it is a complete bridge of power. There is metallic connection all the way round in this arrangement, and where I have inserted the platinum, which offers some resistance to the passage of the force, you see what an amount of heat is evolved,—this is the heat which the zinc would give if burnt in oxygen, but as it is being burnt in the voltaic battery it is giving it out at this spot. I will now shorten this wire for the sake of showing you that the shorter the obstructing wire is, the more and more intense is the heat, until at last our platinum is fused and falls down, breaking off the circuit.

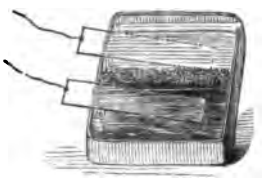
Here is another instance. I will take a piece of the metal silver and place it on charcoal connected with one end of the battery, and lower the other charcoal pole on to it—see how brilliantly it burns. (*fig.* 6.) Here is a piece of iron on the charcoal,

Fig. 6.

see what a combustion is going on; and we might go on in this way burning almost everything we placed between the poles. Now I want to show you that this power is still chemical affinity —that if we call the power which is evolved at this point *heat* or *electricity*, or any other name referring to its source, or the way in which it travels, we still shall find it to be chemical action. Here is a coloured liquid which can show by its change of colour the effects of chemical action; I will pour part of it into this glass and you will find that these wires have a very strong action. I am not going to show you any effects of combustion or heat, but I will take these two platinum plates, and fasten one to the one pole and the other to the other end, and place them in this solution, and in a very short time you will see the blue colour will be entirely destroyed. See, it is colourless now,—I have merely brought the end of these wires into the solution of indigo and the power of electricity has come through these wires and made itself evident by its chemical action. There is also another curious thing to be noticed now we are dealing with the chemistry

of electricity, which is that the chemical power which destroys the colour is only due to the action on one side. I will pour some more of this sulphindigotic acid into a flat dish and will then make a porous dyke of sand separating the two portions of fluid into two parts (*fig.* 7.) and now we shall be able to see whether there is any difference in the two ends of the battery, and which it is that possesses this peculiar action. You see it is the one on my right hand which has the power of destroying the blue, for the portion on that side is thoroughly bleached, while nothing has apparently occurred on the other side. I say *apparently*, for you must not imagine, that because you cannot perceive any action none has taken place.

Fig. 7.

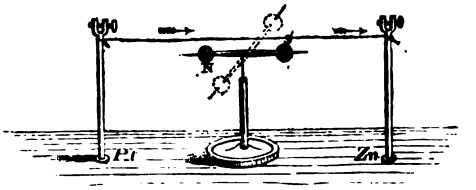


Here we have another instance of chemical action. I take these platinum plates again and immerse them in this solution of copper from which we formerly precipitated some of the metal, when the platinum and zinc were both put in it together. You see that these two platinum plates have no chemical action of any kind, they might remain in the solution as long as I liked, without having any power of themselves to reduce the copper; but the moment I bring the two poles of the battery in contact with them, the chemical action which is there transformed into electricity and carried along the wires, again becomes chemical action at the two platinum poles, and now we shall have the power appearing on the left hand side, and throwing down the copper in the metallic state on the platinum plate; and in this way I might give you many instances of the extraordinary way in which this chemical action or electricity may be carried about. That strange nugget of gold, of which there is a model in the other room, and which has an interest of its own in the natural history of gold, and which came from Ballarat, and was worth 8000*l.* or 9000*l.* when it was melted down last November, was brought together in the bowels of the earth, perhaps ages and ages ago, by some such power as this. And there is also another beautiful result dependent upon chemical affinity in that fine lead-tree, the lead growing and growing by virtue of this power. The lead and the zinc are combined together in a little voltaic arrangement, in a manner far more important than the powerful one you see here, because in nature these minute actions are going on for ever, and are of great and wonderful importance in the precipitation of metals and formation of mineral veins, and so forth. These actions are not for a limited time, like my battery here, but they act for ever in small degrees, accumulating more and more of the results.

I have here given you all the illustrations that time will permit me to show you of chemical affinity producing electricity, and electricity again becoming chemical affinity. Let that suffice for the present; and let us now go a little deeper into the subject of this chemical force, or this electricity—which shall I name first—the one producing the other in a variety of ways. These forces are also wonderful in their power of producing another of the forces we have been considering, namely, that of magnetism, and you know that it is only of late years, and long since I was born, that the discovery of the relations of these two forces of electricity and chemical affinity to produce magnetism have become known. Philosophers had been suspecting this affinity for a long time, and had long had great hopes of success—for in the pursuit of science we first start with hopes and expectations; these we realise and establish never again to be lost, and upon them we found new expectations of further discoveries, and so go on pursuing, realising, establishing, and founding new hopes again and again.

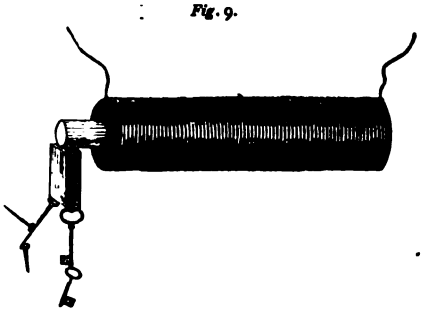
Now observe this: here is a piece of wire which I am about to make into a bridge of force, that is to say, a communicator between the two ends of the battery. It is copper wire only, and is therefore not magnetic of itself. We will examine this wire with our magnetic needle (*fig.* 8.), and though connected with one extreme end of the battery, you see that before the circuit is completed it has no power over the magnet. But observe it when I make contact; watch the needle, see how it is swung round, and notice how indifferent it becomes if I break contact again; so you see we have this wire evidently affecting the magnetic needle under these circumstances. Let me show you that a little more strongly. I have here a quantity of wire which has been wound into a spiral, and this will affect the magnetic needle in a very curious manner, because, owing to its shape, it will act very like a real magnet. The copper spiral has no power over that magnetic needle at present, but if I

Fig. 8.



cause the electric current to circulate through it, by bringing the two ends of the battery in contact with the ends of the wire which forms the spiral, what will happen? Why one end of the needle is most powerfully drawn to it; and if I take the other end of the needle it is repelled; so you see I have produced exactly the same phenomena as I had with the bar magnet,—one end attracting and the other repelling. Is not this then curious to see that we can construct a magnet of copper? Furthermore, if I take an iron bar, and put it inside the coil, so long as there is no electric current circulating round, it has no attraction,—as you will observe if I bring a little iron filings or nails near the iron. But now if I make contact with the battery they are attracted at once. It becomes at once a powerful magnet, so much so that I should not wonder if these magnetic needles on different parts of the table pointed to it. And I will show you by another experiment what an attraction it has. This piece and that piece of iron and many other pieces are now strongly attracted (*fig.* 9.), but as soon as I break contact the

Fig. 9.

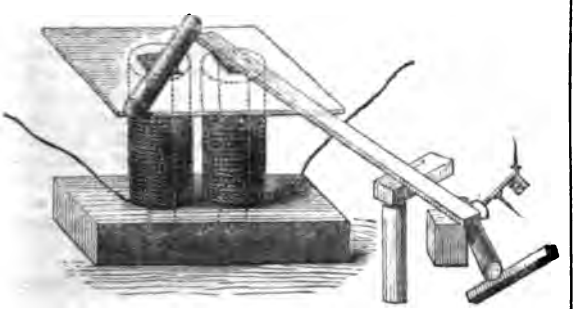


power is all gone and they fall. What then can be a better or a stronger proof than this of the relation of the powers of magnetism and electricity? Again here is a little piece of iron which is not yet magnetised. It will not at present take up any one of these nails; but I will take a piece of wire and coil it round the iron (the wire being covered with cotton in every part so that it does not touch the iron), so that the current must go round in this spiral coil; I am in fact preparing an *electro-magnet* (we are obliged to use such terms to express our meaning, because it is a magnet made by electricity,—because we produce by the force of electricity a magnet of far greater power than a permanent steel one). It is now completed and I will repeat the experiment which you saw the other day, of building up a bridge of iron nails; the contact is now made and the current is going through; it is now a powerful magnet; here are the iron nails which we had the other day, and now I have brought this magnet near them they are clinging so hard that I can scarcely move them with my hand, (*fig.* 10.) But when the contact is

Fig. 10.

broken, see how they fall. What can show you better than such an experiment as this the magnetic attraction with which we have endowed these portions of iron? Here again is a fine illustration of this strong power of magnetism. It is a magnet of the same sort as the one you have just seen. I am about to make the current of electricity pass through the wires which are round this iron for the purpose of showing you what powerful effects we get. Here are the poles of the magnet; and let us place on one of them this long bar of iron. You see as soon as contact is made how it rises in position (*fig.* 11.); and if I take

Fig. 11.



such a piece as this cylinder, and place it on, woe be to me if I get my finger between; I can roll it over, but if I try to pull it off, I might lift up the whole magnet, but I have no power to overcome the magnetic power which is here evident. I might give you an infinity of illustrations of this high magnetic power. There is that long bar of iron held out, and I have no doubt if I were to examine the other end I should find that it was a magnet. See what power it must have to support not only these nails but all these lumps of iron hanging on to the end. What then can surpass these evidences of the change of chemical force into electricity, and electricity into magnetism? I might show you many other experiments whereby I could obtain electricity and chemical action, heat and light from a magnet, but what more need I show you to prove the universal correlation of the physical forces of matter, and their mutual conversion one into another?

And now let us give place as juveniles to the respect we owe to our elders; and for a time let me address myself to those of our seniors who have honoured me with their presence during these lectures. I wish to claim this moment for the purpose of tendering our thanks to them, and my thanks to you all for the way in which you have borne the inconvenience that I at first subjected you to. I hope that the insight which you have here gained into some of the laws by which the universe is governed, may be the occasion of some amongst you turning your attention to these subjects; for what study is there more fitted to the mind of man than that of the physical sciences? And what is there more capable of giving him an insight into the actions of those laws, a knowledge of which gives interest to the most trifling phenomenon of nature, and makes the observing student find

"—— tongues in trees, books in the running brooks,
Sermons in stones, and good in everything."

HANOVER SQUARE ROOMS — *Feb.* 13. 1860.

Chemical Properties of Milk.

On Monday Evening, Feb. 13, a small party of ladies and gentlemen (the latter mostly medical men) attended at the Hanover-Square Rooms, to hear a paper read *On the Comparative Chemical Properties of Human and Animal Milks considered in relation to some Physiological Facts.* Unfortunately the paper offered but little which could come within the province of an exclusively chemical journal, and therefore calls for no extended notice from us.

The object of the authoress (a benevolent lady, who has devoted a great deal of attention to the subject) was to show that when children are brought up by hand, animal milks form but imperfect substitutes for the natural aliment. Cow's milk alone did not contain enough of the combustible or heat giving elements, more of which was needed by weak infants who had not the advantage of the warmth obtained by lying at the breast. She therefore recommended the addition of one sixth or one eighth of vegetable food to the cow's milk. Well cooked bread food or baked flour might be made proper, but if carelessly prepared it was very prejudicial. In the Paris hospitals when the sick infants were withdrawn from the breast and fed upon arrowroot or rice they almost all died; and upon examination their intestines were found lined with undigested starch. It was particularly important that infants' food should be well cooked. The great object of the paper, however, was to insist that nothing could be found which would perfectly replace the mother's milk. In all milks, the authoress stated, there exists an essence, quality, or property — beyond the power of analytical chemistry to separate or distinguish, but no less certainly present — which gives to each a distinctive characteristic, and fits it only for the nourishment of its kind. Even the milk of individuals differed in some subtle ingredient, as is shown by the instinctive aversion which infants sometimes show to particular nurses, whose breasts they absolutely refuse to take.

Dr. Druitt (who occupied the chair) afterwards addressed the meeting on the importance of the subject, and the Superintendant Registrar of Marylebone read some statistics showing the enormous mortality of children under four years of age, 24 per cent. of the whole number dying in the first year. Many of the deaths were directly ascribed to the want of breast milk and improper food, and no doubt a very large proportion of the rest might be traceable to the same cause. The deaths of illegitimate children in their first year he showed was double that of other infants. They were generally put out to nurse with old women, who fed them upon ordinary oatmeal.

Dr. Routh said he did not concur in all that was stated in the paper. Nature intended infants to live entirely on animal food — even the young of graminivorous animals were for a time, until the teeth were developed, nourished on an exclusively animal diet. The offspring of birds were at first fed with larvæ and other animal matters collected by the mother. He believed that much of the excessive mortality was caused by vegetable food. Bread food he considered especially bad — opium was as innocent, and was less troublesome. The effect of alum, which nearly all bread contains, is to fix phosphoric acid in a perfectly insoluble form, and thus to deprive the infant of an ingredient essential for its nourishment. Another objection to the use of vegetable food, was the absence of chloride of potassium, a salt which was absolutely required for the progress of the cell-growth. When teeth are formed vegetable food may be used with advantage. Before starch can become nutritious it must be converted into sugar, and infants at an early age have no salivary glands to supply the ferment necessary to effect the conversion. Cows and goats fed exclusively upon beet root, the doctor said, produced milk exactly like the human secretion, and he recommended that experiments on infantine nutrition should be tried at the Foundling Hospital.

Mr. Harry Lobb said he had introduced a short time ago a *perfect* milk, which was prepared as follows: — dissolve a teaspoonful of sugar of milk in two ounces of boiling water, and then add one ounce of cow's milk, with a teaspoonful of cream. Thinking that after the publication of this paper a great demand for sugar of milk would arise, he ordered *a ton* of the substance from Switzerland; but only two medical men had recommended his milk, and although he had sold a little to the homœopaths, the greater part of his sugar of milk remained on his hands!!

Mr. Ballard and Dr. Druitt afterwards addressed the meeting — but their observations were entirely medical. A vote of thanks to the lady was passed accompanied by a request that she would publish the paper which had been read.

NOTICES OF BOOKS, PATENTS, &c.

Stories of Inventors and Discoverers in Science and the Useful Arts. A Book for Old and Young, by John Timbs, *F.S.A.* London. 1859.

Timbs is nothing to criticise in a book of this kind. Usually happy in the selection of a subject, Mr. Timbs always writes a readable and instructive book on every matter which he takes in hand. The present volume is no exception to this rule. It contains sixty stories of inventors from Archimedes to Brunel, and includes a notice of most of the discoveries in science and the useful arts down to the invention of the electric telegraph. We might fill a number of our paper with interesting extracts, but can only find room for one or two. No doubt our readers would like to know something of the history of Prince Rupert's drops (as they are called), which Dr. Faraday exhibited at his lecture on "Cohesion." (See page 67 Chemical News.)

"These philosophical toys take their English name from having been first made known in England by Prince Rupert, and not from his having invented them as commonly supposed. The drops were first brought to England in 1660, and in the proceedings of the Royal Society occurs this entry:

"'Aug. 14. Sir Robert Moray brought in glass drops, an account of which was ordered to be registered.'

"Accordingly, the first volume of the register book contains a very long account of them and their manufacture. They were so well known when *Hudibras* was written as to be used by Butler in popular illustration. In part ii. canto 2 we have:

"'Honour is like that glassy bubble
That finds philosophers such trouble:
Whose least part crack'd, the whole does fly,
And wits are cracked to find out why.'

"M. Rohalt in his *Physics* calls the drop a kind of miracle in nature, and says:

"'Ed. Clark lately discovered and brought it hither from Holland, and which has travelled through all the universities in Europe, where it has raised the greatest curiosity, and confounded the reason of the greatest part of the philosophers.'"

The drops have long since ceased to puzzle the philosophers, but they remain as great curiosities as ever.

We have seen the engineers and philosophers at fault with regard to steam navigation and railroads, and it seems they were no less mistaken in their opinion about the practicability of safely lighting the streets with gas. Soon after the establishment of the National Light and Heat Company in 1810, an extensive explosion took place on their premises in the Horseferry Road, and a committee of the Royal Society was, at the request of government, appointed to investigate the matter.

"They met several times at the gas works to examine the apparatus, and made a very elaborate report, in which they stated as their opinion, that if gas lighting was to become prevalent, the works ought to be placed at a considerable distance from all buildings; and that the reservoirs should be small and numerous, and always separated from each other by mounds of earth or strong party walls. This committee was composed of Sir Joseph Banks, Sir C. Blagden, Col. Congreve, Mr. Lawson, Mr. Rennie, and Dr. Young. In the company's application to Parliament, one of their witnesses, Mr. Accum the chemist, was bitterly ridiculed by Mr. Brougham, F.R.S.; and Sir Humphry Davy asked if it were intended to take the dome of St. Paul's for a gasometer! In short, as Dr. Arnott remarks, 'Davy, Wollaston, and Watt, at first gave an opinion that coal gas could never be safely applied to the purpose of street lighting.' However, the invention progressed, and in 1822 St. James's Park was first lighted with gas."

The London companies, we are informed, have now 2000 miles of main pipes, and storage for ten million cubic feet of gas. Both "old and young" will find much that will interest them in Mr. Timbs's book.

Improvements in obtaining or extracting Quinine and the Principal Organic Alkalies. (A communication.) W. Clark.

A decoction of the bark in dilute hydrochloric or sulphuric acid is obtained; an alkali or alkaline carbonate is then added until precipitation ceases. The liquor holding the precipitate in suspension is then boiled, and a certain quantity of solid fatty acids added; these acids then melt and form a layer on the surface with which all parts of the liquid under the influence of ebullition come in contact successively, and the quinine being dissolved in the water combines with the fatty acids and forms with it a perfectly insoluble soap. After a certain time the precipitate becomes of a blackish colour. The liquor is then allowed to cool, when the fatty acids become solidified on the surface, and are removed in the form of a cake and then boiled with distilled water for removing any impurities with which it may be mechanically combined. This is continued until the fatty matter yields nothing more to the pure water; it is then boiled in water acidulated with sulphuric acid, and the excess of acids subsequently saturated by an alkali. Some dark matters will be precipitated, and after filtration a crystallised block of sulphate of quinine will be obtained by cooling, which block may be purified as usual.

CORRESPONDENCE.

Poison Labels.

To the Editor of the Chemical News.

Sir,—As the necessity for the sale of many poisonous substances is I think admitted by all who are familiar with the requirements of the public, it is desirable, as much as possible, to make them fully aware of the risk that attends their sale; with that end in view, I have had the subjoined label printed, and attach it to every packet of poison sold, such as oxalic acid, red and white precipitates, &c.

> CAUTION!!!
>
> As the sale of all Poisonous Substances is attended with great risk, it is earnestly requested that this preparation may be kept away from Children, and not placed where Food, &c. is deposited. —— will always supply a label with the word "POISON" on it to affix to bottles, &c.

I venture to send this to you, that if there is any novelty in the idea, it may be at the service of others who will be able to improve upon it.

X.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Oxides of Cerium, and the Yellow and Red Sulphates.—Cerium, according to Rammelsberg[1], may be obtained from lanthanum and didymium perfectly pure by the process of M. Hermann, which consists in precipitating the subsulphate of ceroso-ceric oxide by means of water.

The *protoxide of cerium*, CeO, is obtained by heating the carbonate or oxalate in a current of pure hydrogen. It is a bluish-grey powder, which, exposed to air, becomes ceroso-ceric oxide, and takes a yellow colour: its hydrate is white.

Ceroso-ceric oxide, $CeO.Ce_2O_3$, is procured by calcining in the air either the carbonate, oxalate, or cerous nitrate. It is yellowish-white, with a slightly red tint, becoming yellow for a time when heated, and only dissolves in concentrated sulphuric acid, forming an orange coloured liquid. Hydrogen reduces it to cerous oxide. Neither calcination in

[1] *Journal für Praktische Chemie*, Bd. lxxii. s. 67, 1859.

oxygen nor fusion with nitre will oxidise it further. Its hydrate contains 3 atoms of water, and is formed when chlorine is passed into a solution of potash, holding in solution the hydrate of cerous oxide.

From the orange coloured solution of ceroso-ceric oxide in sulphuric acid the following salts may be obtained;

The *brown-red or orange sulphate* (*a*), crystallised in hexagonal prisms, which contains $3(CeO.SO_3) + Ce_2O_3 3SO_3 + 18\,HO$. This salt is decomposed by water, separating into a sulphur-yellow basic salt, and giving with potash a greyish-red precipitate, which contains $3CeO + Ce_2O_3$, which becomes yellow in the air, changing into $CeO.Ce_2O_3$, and attracting a small quantity of carbonic acid.

A *yellow sulphate* (*b*) irregularly crystallised, which contains $CeO.SO_3 + Ce_2O_3.3SO_3 + 8$ aq. With water it behaves like salt (*a*).

The *basic ceroso-ceric sulphate*, formed by the action of water on the preceding salts, constitutes a clear yellow precipitate, whose composition may be represented by the formula

$$2(CeO.SO_3) + 2(Ce_2O_3)\,SO_3 + 6\text{ aq.}$$

Calcined at a bright red heat all these sulphates leave ceroso-ceric oxide. When solutions of the red-brown ceroso-ceric sulphate (*a*) and sulphate of potash are mixed a yellow precipitate is formed, constituting a mixture of double salts.

With sulphate of ammonia a crystalline granular precipitate is formed, but at the same time beautiful orange crystals may be obtained, whose composition answers to the formula

$$9(NH_4O.SO_3) + [CeO.SO_3 + 2(Ce_2O_3\,3SO_3)] + 12\text{ aq.}$$

Calcined, these double ammoniacal salts leave ceroso-ceric oxide.

The mean of four analyses of *cerite* gave as the composition:

		Oxygen.
Silica	19·18	9·96
Protoxide of cerium	64·55	11·17
Oxides of lanthanum and didymium	7·28	
Lime	1·35	
Protoxide of iron	1·54	
Water	5·71	5·09
	99·61	

These proportions are very nearly expressed by the formula

$$\left.\begin{matrix}CeO\\LaO.DiO\\CaO.FeO\end{matrix}\right\}^{2} SiO_3 + \text{aq.}$$

On the Isomorphism of the Oxides of Tin, Silica, and Zirconia.—After the last experiments of Marignac, who has proved the isomorphism of the fluostannates and fluosilicates, it seems certain that the correct formula for silica is SiO_2. It appears probable also that zirconia is constituted in a similar manner, and may be represented by the formula ZrO_2. This has led M. G. Rose[2] to regard zirconium as a combination of two isomorphous substances, zirconic acid, ZrO_2, and silicic acid, SiO_2, capable of crystallising separately in the right prismatic type with square base. Oxide of tin closely approaching by its form and angles, M. G. Rose concludes that the oxides of tin, silica, and zirconium are isomorphous.

II. ORGANIC CHEMISTRY.

Products of the Oxidation of Legumine.—From legumine extracted from lentils and submitted to the action of bichromate of potash and diluted sulphuric acid, Froehde[3] has obtained by distillation an acid liquid having the odour of hydrocyanic acid, which does not give with the salts of silver the characteristic reaction of aldehydes. This liquid contains a trace of formic acid. By distilling it again there may be separated one portion having an etherial aromatic odour, and another portion having a strong acid reaction. From this last, by proper treatment, may be obtained benzoic, valerianic, butyric, acetic, propionic, caproic, and perhaps caprylic acids.

Oxalantine, a new derivative of Uric Acid.—It is known that alloxan and parabanic acid have some analogous properties. In contact with alkalies both fix two atoms of water, and are converted into acids:

$$\underbrace{C_8H_2N_2O_8}_{\text{Alloxan.}} + 2\,HO = \underbrace{C_8H_4N_2O_{10}}_{\text{Alloxanic acid.}}$$

$$\underbrace{C_6H_2N_2O_6}_{\text{Parabanic acid.}} + 2\,HO = \underbrace{C_6H_4N_2O_8}_{\text{Oxaluric acid.}}$$

When boiled with alkalies they fix four atoms of water and break up, one into urea and mesoxalic acid, the other into urea and oxalic acid:

$$\underbrace{C_8H_2N_2O_8}_{\text{Alloxan.}} + 4\,HO = \underbrace{C_2H_4N_2O_2}_{\text{Urea.}} + \underbrace{C_6H_2O_{10}}_{\text{Mesoxalic acid.}}$$

$$\underbrace{C_6H_2N_2O_6}_{\text{Parabanic acid.}} + 4\,HO = \underbrace{C_2H_4N_2O_2}_{\text{Urea.}} + \underbrace{C_4H_2O_8}_{\text{Oxalic acid.}}$$

On the other hand, by the action of reducing agents on alloxan, alloxantine is formed. The corresponding term also exists in the parabanic acid series. It is a new body, to which the name *oxalantine* has been given.

$$2\underbrace{C_8H_2N_2O_8}_{\text{Alloxan.}} + 2\,H = \underbrace{C_{16}H_4N_4O_{14}}_{\text{Alloxantine.}} + 2\,HO$$

$$2\underbrace{C_6H_2N_2O_6}_{\text{Parabanic acid.}} + 2\,H = \underbrace{C_{12}H_4N_4O_{10}}_{\text{Oxalantine.}} + 2\,HO$$

Sulphuretted hydrogen does not act on parabanic acid; but if dilute hydrochloric acid and a little zinc are added to parabanic acid, hydrogen is slowly disengaged, and there is formed a white crystalline powder, which is a compound of oxalantine with oxide of zinc. This powder is washed with water and decomposed by sulphuretted hydrogen. The solution properly concentrated furnishes oxalantine in the form of a crystalline crust. It is but slightly soluble in water, and is almost insoluble in alcohol and ether. The aqueous solution is slightly acid. Heated with oxide of mercury or nitrate of silver it remains perfectly transparent; but when ammonia is added, reduction immediately takes place. Heated with moderately strong nitric acid or with peroxide of lead oxalantine undergoes no oxidation. Its composition is expressed by the formula $C_{12}H_4N_4O_{10} + 2\,HO$, in which we admit two equivalents of water of crystallisation; but this water cannot be got rid of by heat without altogether decomposing the body.

Oxalantine dissolves easily in caustic and carbonated alkalies, in the latter with effervescence. By evaporating these solutions the author[4] thinks he has obtained oxalurates, but he has not established the point with certainty.

III. CHEMICAL ANALYSIS.

New Method of detecting Nitric Acid in the Dry Way.—Professor W. Stein[5] gives a method for detecting nitric acid in the dry way when combined with bases. When heated the nitrates of potash and soda give off oxygen, and form fixed nitrites. The nitrates of baryta, strontia, and lime, together with those of magnesia, alumina, and the heavy metals, when heated give up the nitric acid, which is split into oxygen and nitrous acid. As however we do not always know with what base the acid may be combined, the author recommends the following mode of testing. He heats the substance in a test tube either with bisulphate of potash or oxide of lead, placing in the upper end of the tube a strip of filtering paper moistened with a slightly acid solution of pure sulphate of iron. If the nitrates are present only in so small a quantity that the nitrous vapour is not itself perceptible, the paper becomes of a yellowish-brown colour. In this way the author discovered the 2000th part of nitric acid

[2] *Poggendorff's Annalen der Physic und Chemie*, Bd. cvii. s. 602.
[3] *Journal für Praktische Chemie*, Bd. lvii. s. 290.
[4] M. H. Limpricht, *Ann. der Chem. und Pharm.* cxi. p. 193.
[5] *Polytech. Centralblatt*, p. 1624, 1859.

in a mixture, which by the usual moist way would have been impossible. The process is particularly applicable for the detection of nitric acid in spring waters. In applying the test it is necessary to guard against heating the paper. In the presence of chlorides the employment of bisulphate of potash is objectionable, because the liberated chlorine colours the paper by forming chloride of iron. The presence of protoxide of iron or much organic matter in the substance also interferes with the bisulphate of potash test.

Estimation of Free Nitric Acid.—Schaffgotsch[6] points out that free nitric acid may be estimated in the form of nitrate of ammonia, a salt of perfectly constant composition, which can be easily weighed in a covered crucible after being dried at 240° F.

Separation of the Sulphates of Lead and Baryta.—Hyposulphite of soda dissolves sulphate of lead, and may be used to separate this salt from the sulphate of baryta. To effect this separation a concentrated solution of the hyposulphite must be added to the mixture of the two salts, and the whole gently warmed, taking care that the temperature does not exceed 68°; at a higher temperature sulphite of lead is formed, which is insoluble in the hyposulphite.

The residue of sulphate of baryta is carefully washed and weighed; to control the results the lead in the hyposulphite may be estimated.

SCIENTIFIC NOTES AND QUERIES.

Water-purifying Patents. — Sir, — While I have no desire to continue any controversy with your correspondent Mr John Horsley, of whom I know nothing, I trust, notwithstanding your editorial note of last week, that you will afford me room to say, that even (were the peroxide of manganese mentioned, as he says it is, "in book after book," in connection with the purification of water, yet that fact would not in the slightest degree invalidate my patent of 1857. At the same time it seems somewhat odd that the correspondent who told your readers a week or two back that he had "found the peroxide of manganese to be a most invaluable agent, not only in decolorising, but deodorising water," should now, on finding himself anticipated, inform the same readers, that the fact is to be "found in book after book."

What other could have been his object in thus gratuitously informing chemical readers of what he had "found," if it were not to leave them to infer the discovery to be his own? Certainly I thought so, otherwise I should not have replied to his letter.

In scientific literature it is an acknowledged rule, that when a writer, be he who he may, says in connection with an experimental investigation that "I have found" such and such to be so — without any other authority being mentioned, he intends it to be implied that *he*, the writer, has discovered the fact in question.—*Thomas Spencer.*

A newly imported Article from Japan. — Sir, — I enclose you a specimen of the above, which is now in the London docks. In appearance it is not unlike some kinds of French isinglass, is soluble in boiling water to the extent of four fifths, but requires longer boiling, and a much larger quantity of water than ordinary isinglass, which it was represented to be. The resulting jelly is neither so bright nor so firm or tough as that made from genuine glass, nor will it bear much working with a spoon, which separates interstitial water.

Chemical tests go to prove that it is entirely *destitute* of that peculiar principle known as "animal gelatine" upon which the commercial value of isinglass depends.

The *incineration* test, however, proves that the substance in question is *not* animal matter at all, but a preparation of pectin, or vegetable jelly, analogous to Carrageenin, which has been rolled out into a sheet form and dried: as such it may be useful as a diet and demulcent for invalids, being nicer and cleaner looking than carrageen or Irish moss.

Fifty grs. of the substance yielded four grains of white ash, which nearly all dissolved in distilled water, and showed the presence of chlorine, sulphuric acid, lime, and soda. — *John Horsley, F.C.S*

[6] *Poggendorff's Annalen der Physic und Chemie*, cviii. p. 64.

MISCELLANEOUS.

Medical Stores for the Navy.—On Tuesday evening last, Lord C. Hamilton asked the Secretary of the Admiralty whether the attention of the Board had been directed to the quality of the wine supplied to the Navy for medical purposes, it having been described as unfit for the use of invalids, although exempt from duty; and also whether he could give an assurance to the House that the drugs supplied to the Navy are not of an equally adulterated and deleterious description. Lord C. Paget said the drugs were supplied from Apothecaries' Hall, and were necessarily of the best quality. As regarded the wine, they had not received complaints from any of the ships, but as the statement of the Chancellor of the Exchequer had produced some sensation, he would direct inquiries to be made on the subject.

Treaty with France.—In the treaty just concluded with the Emperor of the French, her Majesty engages to recommend to Parliament to enable her to abolish the duties of importation on the following articles: — Sulphuric and all other mineral acids; lucifers of every description; percussion caps; corks; articles covered with copper by galvanic process; manufactures of lead, enumerated or not enumerated; sulphate of quinine and salts of morphine.

His Majesty the Emperor of the French engages, that on the following articles of British production, imported from the United Kingdom into France, the duties shall in no case exceed thirty per cent. *ad valorem*, the two additional decimes included: —Chemical productions, enumerated or not enumerated; extracts of dye woods; garancine; common soap of every description, and perfumed soaps.

With respect to chemical productions, of which salt is the basis, the excise or inland duties shall be added to the amount of the above specified duties.

The Chancellor of the Exchequer also proposes to make the following articles free of duty: — Almonds; cassia lignea; chloroform; cinnamon; cloves; cocculus indicus; daguerreotype plates; extracts, as denominated in the tariff; ginger; glass of all kinds; grains (Guinea and of paradise); liquorice paste, powder, and juice; mustard; nux vomica; opium; pimento; quassia; salicine; carraway seeds; stearine; and tallow.

Until the 31st of March 1861, the duty on corks to be: — Ready made, 3*d.* the lb.; squared for rounding, 4*s.* the cwt.

The Adulteration of Food Bill passed the second reading in the House of Commons on Wednesday last.

Physician's Cane.—An enterprising American has taken out a patent for the above article. It consists in having the cane hollow or formed of a tube closed at its bottom and having a semi-tube attached to the knob or handle, the said semi-tube fitting within the cane and allowed to move freely in and out of it, and forming a receptacle for vials containing medicine. The invention is chiefly designed for country physicians who are compelled to carry medicines with them.

Liquid Glues.—Dissolve 33 parts of best glue on the steam bath in a porcelain vessel, in 36 parts of water. Then add gradually, stirring constantly, 3 parts of aqua fortis, or enough to prevent the glue from hardening when cool. Or dissolve 1 part of powdered alum in 120 parts of water, add 120 parts of glue, 10 of acetic acid and 40 of alcohol, and digest. — *Druggist's Circular.*

ANSWERS TO CORRESPONDENTS.

Inops.—We will endeavour to obtain an authoritative answer to your question.

Dr. Meyer's communication is in the press.

J. B. E.— x and y are intended to represent any whole number whatever. In the formula referred to

$$x(NH_4Cl+KNO_6)=(x-y)(NH_4Cl+KNO_6)+y(NH_4NO_6+KCl)$$

x may represent any number provided y is a lower number.

Œlas.—1. We do not know. 2. Piesse's.

Pyrometer.—To convert centigrade degrees into Fahrenheit degrees, multiply by 9, divide the product by 5, and add 32: to convert Fahrenheit into centigrade degrees, substract 32, multiply by 5, and divide by 9. To reduce the degrees of Reaumur to Fahrenheit, multiply by 9, and divide by 4. Such a plan as our correspondent suggests is under consideration.

P. M. Henschikoff— *W. M.* (Manchester) —*Excelsior* —*B.*— *Phosphate* —received. Answers next week.

Book received.—*On the Sewerage of Towns as it affects British Agriculture*, by Mr. Alderman Mechi.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office, 12 and 13 Red Lion Court, Fleet Street, London. E. C.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Organo-metallic Radicals, by M. AUGUSTE CAHOURS.[1]

CERTAIN bodies of a more or less complex nature which behave exactly in the same way as simple substances, have received the name of radicals. These bodies have particularly fixed the attention of chemists since the publication of Bunsen's work on Cacodyle, and the researches of Frankland on Zinc-ethyl. I have resumed the study of these interesting products, which I commenced some years ago in concert with M. Riche, and I now proceed to give some account of the remarkable part which they play with regard to oxygen, chlorine, sulphur, &c.

One simple body cannot unite with others in all imaginable proportions: daily experience in fact teaches us that two bodies can only form a very limited number of combinations, and further that when this number exceeds two or three, they have in general but little stability. Such is the case with the compounds of chlorine with oxygen.

Among the various compounds which two simple bodies can form by their mutual union, there is always one which possesses more stability than the others, and towards which these different products necessarily converge. Thus for the alkaline metals the most stable grouping is represented by the general formula RX, while for the salts of iron and its analogues the form is R_2X_3, and for tin and titanium RX_2.

But the greater or less stability of such a grouping is evidently relative only to particular circumstances, since every time that we place under determined conditions the different compounds a body is susceptible of forming, they will invariably be brought to that particular form which alone is possible under these conditions. Everyone knows, for example, that of all the combinations which phosphorus can form with oxygen, the most stable is phosphoric acid. We can under special influences combine phosphorus with other proportions of oxygen; but these various compounds will all, under the action of elevated temperatures converge towards the grouping PO_5. As long as the phosphorus has not assimilated the proportion of oxygen necessary to form phosphoric acid, we can add new quantities, and further, in place of a portion of this oxygen, we may put other simple bodies, such as chlorine, sulphur, &c. so as to produce the substances known as oxychloride and chlorosulphide of phosphorus, belonging like phosphoric acid to the grouping PX_5.

When then we bring in contact two simple bodies capable of uniting directly in well-defined conditions, there exists for these bodies a state of saturation presenting an equilibrium, which it is impossible to go beyond. So long as this state of equilibrium is not attained we may keep on adding to the first body a new proportion of the second, and so on until we arrive at the point of saturation. But there are certain bodies which in uniting with others give rise to products having as great and sometimes even a greater tendency to combination than the simple bodies themselves. Such are carbonic oxide, sulphurous acid, &c. which not only absorb new quantities of oxygen with more facility than carbon and sulphur themselves, but which form with chlorine, iodine, &c. compounds corresponding with those which are at the maximum of oxidation. These compounds, which can be separated intact from combinations they may have contracted, and which present all the characters of true simple bodies, have been designated *radicals*.

Every compound may be considered as a molecular system in equilibrium, in which the atoms are attracted one towards another by virtue of more or less powerful affinities. If we replace one or more atoms of one of the elements of the combination, by an equal number of atoms of another substance, we obtain new compounds all presenting the same mechanical arrangement as the primitive product, but whose state of equilibrium will vary according as the reciprocal attractions of the bodies which constitute the new substance are stronger or weaker than those of the original body. It is thus that ammonia can exchange all or part of its hydrogen for chlorine, bromine, iodine, carbon, ethyl, the metals, &c. to form compounds belonging to the same system, but presenting the most variable degrees of stability.

Ammonia resisting perfectly a dull red heat, it is easily explained how it is that chloride of nitrogen is decomposed at temperatures much lower than boiling water, the mutual affinity of chlorine and nitrogen being incomparably weaker than that which induces nitrogen to unite itself with hydrogen.

If we remove an atom from a compound without replacing it, and if the new compound which results from the subtraction presents a certain stability, it is able to fix anew the atom eliminated, and so reproduce the original body, or to combine with any other simple body to form compounds of the same type, playing then the part of a radical. Thus, when ammonia is acted on by carbon at a red heat, we replace 2 atoms of hydrogen by 2 atoms of carbon, and form hydrocyanic acid, a compound of the same type as ammonia. This by reacting on oxide of mercury gives cyanide of mercury, a body presenting the most perfect analogy with it: then, if we subtract the molecule of mercury there remains the compound C_2N, which, to return to the ammonia type, must needs fix different simple bodies, playing with regard to them, sometimes the part of an electro-positive, and sometimes of an electro-negative element. If cyanogen simulates completely the characters of a simple body, it is owing partly to its stability, and partly to its tendency to pass to the maximum of saturation, by assimilating a molecule of various simple bodies, in order to return to the ammonia type from which it was derived.

When methyl, ethyl, amyl, &c. unite with certain simple bodies, they form products whose affinity for oxygen, chlorine, &c. greatly exceeds that of simple

[1] Abridged from the *Annales de Chimie et de Physique*.

bodies for these substances. Zinc, which only absorbs atmospheric oxygen slowly, and which does not act on pure water at the ordinary temperature, effects with extreme violence the decomposition of this liquid, when it is united either with methyl or ethyl, the molecule of the compound dividing itself into zinc, which unites with the oxygen, and into ethyl or methyl which takes the hydrogen to form hydrides. It is the same when magnesium and aluminum are concerned, and with still greater reason in respect to the more electro-positive metals, such as sodium and potassium.

The metals more electro-negative than zinc, such as tin, lead, mercury, can like the preceding, unite with the alcoholic radicals, forming with them compounds which are endowed with a great affinity for oxygen, chlorine, &c.; but these affinities being weaker, it will necessarily happen either that the term of saturation being attained, the compound behaves like an inert substance in regard to these bodies, or the saturation not being satisfied a simple union takes place.

The compounds of methyl or ethyl with the metal separated intact from their new combinations, will necessarily play the part of an elementary substance. The curious properties of these metallic ethylides and methylides which behave exactly like real metals, more electro-positive than the simple metals they contain, have given rise to very legitimate doubts as to the simple nature of the metals themselves, the more so as, up to the present time, science has not registered a single fact which can support the hypothesis of their elementary character.

Methyl or ethyl, when they unite with the electro-negative bodies which are placed at the head of the series of simple bodies (oxygen, chlorine, bromine, iodine, &c.) form very stable and perfectly neutral compounds; but in proportion as we descend the scale and come towards potassium, which stands at the bottom, we obtain compounds less and less stable, and endowed with such strong affinities for those which occupy the upper extremity that a decomposition of the molecule results, with the formation of very simple and stable products.

Intermediately we obtain compounds endowed with strong affinities for oxygen, chlorine, iodine, &c.; which can enter directly into combinations, and be withdrawn from them intact, thus playing the part of true radicals, unless the proportion of methyl or ethyl forming part of these compounds represents the term of saturation, in which case the new molecule is inapt to enter into combinations.

When a simple body froms with various other simple bodies compounds whose term of saturation is represented by the formula AB_x (x being a very simple whole number) experience shows us that we may form with this simple body and the various alcoholic radicals, (methyl, ethyl, &c.) compounds of different states of saturation. As long as the number of molecules of the alcoholic radical which enters into the combination is lower than x, the new compound formed can unite with oxygen, chlorine, &c. and act in the same way as a true radical. Experience likewise teaches that in proportion as the number of equivalents of the alcoholic radical which unites with A is increased, the compound which results is endowed with stronger and stronger affinities for oxygen, chlorine, iodine, &c.; the acid or neutral principles they were originally passing on towards alkalinity in the most decided manner. Arsenic offers in this respect a most striking and instructive example. This body inclines to form two principal groupings: AsX_3, and as $As X_5$. We are able then to form with arsenic and methyl five well-defined bodies, the last being incapable of producing new combinations, because the term of saturation is attained. Now the experiments of MM. Bunsen, Bayer, Landolt, and my own, show that we can form with arsenic and methyl the four compounds, $AsMe$, $AsMe_2$, and $AsMe_3$, and $AsMe_4$. If we place these various compounds in the presence of an excess of oxygen so as to obtain saturated combinations, we shall have:

$As\ MeO_4$
$As\ Me_2O_3$
$As\ Me_3O_2$
$As\ Me_4O$,

which form with water the following compounds:

$As\ MeO_4$, $2HO$,	a bibasic acid.
$As\ Me_2O_3$ HO,	a monobasic acid.
$As\ Me_3O_2$,	an indifferent body.
$As\ Me_4O$ HO,	a strong base, comparable to potash and soda.

The oxygenated combination which occupies the superior term presents strongly acid characters, and the last possesses so much alkalinity as to rival the most powerful bases.

Nitrogen, like arsenic, is capable of forming five perfectly defined groupings, which may be formularised in the following way: NX, NX_2, NX_3, NX_4 and NX_5. With oxygen we can realise these five groupings, the most interesting of which is the term of saturation NO_5. If we replace in these compounds a part of the oxygen they contain with equivalent quantities of chlorine, we obtain chloronitrous and chloronitric acids, whose constitution perfectly corresponds with the nitrous and hyponitric acids from which they are derived.

Contrary to what we observe with oxygen, we are at present able to isolate but one compound of nitrogen with hydrogen. This body, well known to everybody under the name of ammonia, and whose composition is expressed by the formula NH_3, corresponds with the grouping NX_3. This remarkable compound can exchange one or more of its equivalents of hydrogen for an equal number of elementary molecules or even of groupings more or less complex. Ammonia being endowed with basic properties will produce bases by these substitutions if we replace its hydrogen by bodies endowed with analogous chemical functions, while it will produce neutral bodies and even acids if we replace the hydrogen by bodies whose chemical properties are opposed to it. When, for example, the body which is substituted for hydrogen is methyl, ethyl, amyl, phenyl, &c. we obtain bodies which present not only the most complete parallelism of composition, but whose chemical characters so resemble those of ammonia, that the history of these compounds may be deduced from that of ammonia itself. We may easily imagine the chemical functions of the carbides of hydrogen greatly resembling those of hydrogen; and what is most worthy of attention here is, that the alkalinity of these bodies depends upon the number of equivalents of methyl, ethyl, &c. which are substituted. These results become more striking still, when we consider the compounds resulting from similar substitutions effected in phosphuretted hydrogen. Trimethylphosphine (PMe_3) and triethylphosphine (PE_3) can combine with various acids, which phosphuretted hydrogen cannot do. The last body can only unite with hydriodic acid, and then the combination is so unstable that contact with water is sufficient to destroy it.

If we are unable to form any compound of nitrogen and hydrogen corresponding with nitric acid, and consequently to the form NH_5, we know at least a great numbe

which may be considered as belonging to the same type, and which are comprised in the general formula NH_4Y. Thus, for example, dry ammoniacal gas like many carbides of hydrogen, unites directly volume for volume with hydrochloric, hydrobromic, hydriodic acid gas, &c. to form compounds which enter the preceding formula, that is to say, NH_4Cl, NH_4Br, NH_4I, compounds in which some chemists admit the existence of a radical NH_4. This radical has not yet been obtained in a free state, notwithstanding all the attempts which have been made; and it is much more simple to admit that the union of the two bodies brought into contact produces a particular grouping belonging to the type NH_5, which for nitrogen appears to be the saturating point of the combinations it is susceptible of forming.

It is the same with regard to the derivatives of ammonia known under the names trimethylamine, triethylamine, and triamylamine (NMe_3, NE_3, $NAmy_3$), which can fix MeCl, ECl, AmyCl, to form compounds of the same order, in which it would be necessary to admit the existence of new radical derivatives of ammonium, which have no more been isolated than ammonium itself. Is it not then more simple to admit that nitrogen as well as its congeners is capable of forming various definite combinations whose term of saturation is the form NX_5.

Supposing that some day the term NH_4 should be isolated, which is not unlikely; it is more than probable that like methyl and ethyl, it will furnish under the influence of chlorine and bromine substitution products, and not chlorides and bromides like potassium and sodium. If ammonia does not fix directly two equivalents of oxygen, chlorine, bromine, &c. to form compounds which enter the preceding group, and if it is the same with its derivatives NMe_3, NE_3, $NAmy_3$, it is owing in part to the great alkalinity of these products, to the great affinity of chlorine and bromine for hydrogen, and to the feeble tendency of nitrogen to combination. It is not the same with the corresponding compounds of arsenic and phosphorus. The products PMe_3, PE_3, $AsMe_3$, AsE_3, can absorb two equivalents of oxygen, sulphur, or chlorine: hence the differences we observe between nitrogen and its congeners, although these bodies are allied by very strict analogies.

As the metals form definite combinations with oxygen, chlorine, sulphur, &c. we might suppose with reason that the same bodies would form similar compounds with methyl, ethyl, &c. The beautiful researches of Frankland have made known the methylide and ethylide of zinc, compounds belonging to the form ZnX. Wanklyn has since shown us that the alkaline metals can form analogous combinations, but these are so unstable that at present we only know them united with the methylide and ethylide of zinc. Brought into contact with water, all these compounds immediately decompose, forming oxides of the metals and hydrides of methyl and ethyl, a result easy to understand when we remember that these various products represent saturated compounds containing elements endowed with strong affinities for the elements of water, and consequently very apt to bring about its destruction, entirely decomposing themselves. The ethylide of zinc cannot act as a radical any more than the alkaline ethylides, since they represent the most stable grouping which these metals are capable of forming.

A great number of metals have the power of acting on the iodides of methyl and ethyl in closed tubes at temperatures varying from 120° to 200° C. In some cases we obtain free ethylides, as in the case of magnesium; in others, and especially with tin, we obtain sometimes ethylides, and sometimes combinations of these products with iodine. In the course of my labours I have verified the exactness of most of the facts announced by my predecessors; I have had the honour to register some new facts, and I have especially endeavoured to connect the constitution of these curious compounds with the well known combinations the metals form with oxygen, chlorine, and their analogues.

(*To be continued.*)

TECHNICAL CHEMISTRY.

On the Manufacture of the Carbon Elements for Bunsen Batteries, by JOHN YOUNG, *Manager of the Gas-works, Dalkeith.*[1]

THE advantages attending the use of the Bunsen Battery as a powerful source of electric action has led to its very general adoption, especially in those experiments of a more brilliant character. The peculiar construction of this battery consists in substituting for platinum, carbon of that condition found in the interior of gas-retorts. The difficulty of procuring carbon of this sort, and especially of giving it a proper form when obtained, led to the series of experiments and their results which form the subject of this communication.

Hitherto the supply of prepared carbons has almost exclusively been furnished to this country from the Continent; and so far as they have come under my observation they were made from the retort carbon above mentioned. The precariousness of a supply from this source, and the fact of its being dependent for its continuance upon an evil which gas-engineers are trying all means to overcome, suggested the propriety of finding some compound, and mode of treating it, which would render us equally independent of foreign aid, and that period in the history of gas-lighting when the engineer has attained his object. During the spring of last year these experiments were entered upon; and for several weeks at first occupied my whole attention, and at brief intervals during the summer were resumed. In the first outset we were entirely guided in our procedure by the information of the composition and treatment of the carbons by Professor Bunsen, as given in several works on electrical science; but whether the material used by me, or the mode of treatment differed from that of the Professor we do not know, but the results in our hands were most unsatisfactory indeed. The prescribed composition used by the Professor is "coke and coal in fine powder, heated together in an iron mould, thus forming a mass of solid carbon of the required form. To give greater solidity, they were plunged into a syrup of sugar, afterwards dried, and then submitted to an intense heat in covered vessels." These instructions are apparently plain enough, unencumbered by detail, and would indicate, by their brevity, that the *solid mass of carbon* was so sure of being obtained that more minute instructions were totally unnecessary. In our experiments we employed the finest pieces of Newcastle coke in powder and the finest English caking coal, and followed the recipe with great care. We used (1) cold moulds, afterwards heating them carefully; and (2) red-hot moulds, and packed in the composition in a fused state; and yet the four weeks in which we were so occupied were characterised by one series of failures, during which we had wasted large quantities of sugar, besides less

[1] Transactions of the Royal Scottish Society of Arts.

valuable materials, without receiving a single hint that we were proceeding in the right direction; and not until a partially new process was entered upon did hopes arise that we would ever attain our object. The carbon elements so obtained were either loose and friable, or altogether in a state of powder, or so full of cracks and fissures, when an excess of coal was used, that in either case they were useless. Some of the best we endeavoured to finish; but after repeated soakings in the syrup of sugar, we could with difficulty produce them of sufficient density; and, when attainable, only at such expense as precluded competition in price with those already in the market.

Starting anew, and availing ourselves of the varieties of coke within reach, and trusting to our own observations for guidance, we entered upon a new series of experiments with different kinds of coke, mixed in various proportions, and differently treated. Among failures, we also had hints of success, and from noting the changes by which these favourable hints had been furnished, we were able to proceed under more cheering prospects. The results of these experiments were, that the coke from the Marquis of Lothian's parrot coal, as left in the gas retort, was best. What peculiarity in this coke should make it superior we cannot say, unless it be the small amount of ash that it contains; but when used by us, it was always covered by a peculiar glistening, silvery deposit of carbon from its own gas. The amount of ash in the coke we found to be less than 7 per cent.

After many trials, we obtained the best results from the following mixture and mode of treatment — viz. 64 per cent. by weight of coke powder, and 36 per cent. of English caking coal in powder, well mixed, and moistened with a solution of sugar or starch, until the mass, when pressed in the hand, retained its form. When starch was used, it was in the form of mucilage; and when syrup of sugar was used, it was composed of one part of sugar to one and a half of water. The prepared composition was pressed very hard into moulds of the required form, and when taken from the mould the cakes were set aside to dry. The use of sugar or starch in the composition is to cause the adhesion of the particles of coke and coal powder, so that they retain the form of the mould, and when dry become a hard cake that can be handled, and closely packed into the coking-mould. The part of the process referred to is conducted precisely the same as in the manufacture of ordinary bricks; but the similarity of manufacture goes no further, as all air has to be excluded from the carbons, otherwise combustion ensues, and entirely destroys them. To prevent the action of the air, the coking is done inside a gas retort, into which a small quantity of coal had been introduced to expel the air. The box or mould in which the bricks were packed during the coking contained thirteen carbons at one time. The length of the box was equal to the thickness of the whole thirteen, including plates of iron of ¼ inch thickness, which were placed between them, to prevent the carbons from fusing together. The breadth of the box was equal to the length of the carbons, and the depth equal to the breadth of the carbons. The mould with cover was so constructed, that the encased carbons should be closely clamped up and compressed between the plates while coking. The great tendency that the caking coal has to tumify while in fusion, by the escape of the gas, made this precaution the more necessary; and unless attended to the carbons would have been loose and porous. The box and its contents were in the retort for about one hour and a half, at a bright cherry-red heat; and when taken out were covered over with dry dust until cold, to prevent the air from acting on the carbons through the chinks round the cover. When taken from the box the carbons have a close surface, owing to the iron plates compressing the exuding fused coke. At this stage they have no electrical action, and are entirely dependent upon the subsequent parts of the process for the deposit of carbon to bestow this property. From this point in the manufacture my mode of treatment is new, and depends for the closing of the pores in the coke to the fixed carbon from a soaking of coal tar, and the carbonaceous deposit from gas during its liberation from the coal. My experiments upon sugar, as a source of cementing carbon, showed me that at the best it would be expensive, and exceedingly slow in its action, from the low percentage of fixed carbon that it left. When the syrup used was composed of equal weights of sugar and water, the fixed carbon was only 13 per cent. of the liquid absorbed, or 26 per cent. of the sugar in the solution. At this rate, every ounce weight added to the carbons would cost 1½*d.* with sugar at its present cheap rate, besides the additional trouble of having the carbons to dry after each soaking. In using coal tar as a substitute, we first heated it to a temperature of 300°, so as to drive off the naphtha hydocarbons, which left it in a semi-pitched condition; and while still hot the coke bars were soaked in it till saturated, and sank to the bottom. The percentage of fixed carbon left in the coke after the soaking, and heated to redness, was 32·5 per cent. of the tar absorbed, or 2½ times the weight obtained from sugar, and secured at an infinitely less cost. Pure tar carbon is among the best that I have yet tried for Bunsen Batteries, and it was the success in some experiments that I was making with it that induced me to try it as a source of fixed carbon for the purpose now mentioned.

Three separate soakings in the tar, as described, and as many times heated to a high temperature, are necessary fully to close the pores of the coke. Before the last steeping, the carbons are ground upon a flat stone into the required shape. In grinding a little water is used, but only so much as may form the abraded powder from the carbons into a pasty state; and as the carbons are still absorbent at this stage, they imbibe the water from the paste, and leave the particles of carbon deposited in the pores on the surface, thereby leaving the close surface shown in the finished state. The carbons are again soaked in tar, and charred at a high temperature, when the process is completed by the final smoothing on a flat stone.

The manufacture of the carbons is conducted simultaneously with the process of gas-making; and thereby, with economy of heat, a considerable amount of carbon is deposited from the gas itself, in addition to the fixed carbon from the tar absorbed. For convenience of having them properly placed upon the coal in the retort, a long semicircular trough of iron is prepared (similar to a water run for eaves of houses) to contain from twelve to twenty at one time, and after the charge of coal is introduced, and before closed up, the long trough and its contents are thrust in over the coals, close up to the roof of the retort, and allowed to remain till the charge of coal is wrought off — a period of nearly three and a half hours. On being withdrawn, the carbons are scattered about, to cool as rapidly as possible, and prevent their burning away by the action of the air; and when cold they receive the slight rub to smooth them which finishes the process.

I do not wish it to be understood that I consider these carbon elements have reached their perfect state. This notice only shows the process in a comparatively infant stage; and I hope to be able to prosecute the experiments to greater maturity, so as to be able to place a still better article in the hands of the student of electricity.

PHARMACY, TOXICOLOGY, &c.

The Preparation of an Aërated Chalybeate Water, by M. Sarzeau.[1]

When clean pieces of iron are placed in a solution of carbonic acid prepared at 50° Fahr., and under normal pressure, small bubbles of gas are seen to form, which increase in size and are slowly disengaged. If platinum wire is rolled round the pieces of iron, the phenomenon is more apparent, and the experiment quicker made. By leaving the iron in the liquid until no more bubbles are seen to form, we obtain a liquor with a marked inky flavour, and which has all the properties of a solution of a protosalt of iron. If the liquor be heated it is at first turbid, then becomes milky, afterwards ochry, and at last, when it boils it suddenly changes to a deep brown. On cooling it deposits a substance of the same colour, which, separated by filtration, dried in the air, and dissolved in hydrochloric acid gives a mixture of the protochloride and perchloride of iron. If a magnet be brought in contact with the brown matter when dry it is found to adhere, showing that by heating a solution of carbonate of iron magnetic oxide is formed.

The preparation of an aërated chalybeate water is very simple. We have only to place some clean pieces of iron in the upper vessel of one of the ordinary gazogenes, set the apparatus in a cool place for 48 hours, by which time a liquid is obtained which only differs from the before-mentioned in the excess of carbonic acid which it contains. The taste is sensibly inky, but it is not at all disagreeable so drink.

Two experiments have been made to determine the amount of carbonate of iron in solution. In both cases a quantity of peroxide was found corresponding to rather more than half a grain of the protocarbonate in 100 grammes (3 ozs. 1½ drs. 13 grs.) of the water. The quantity of iron in the water may be increased or diminished by leaving the two in contact for longer or shorter periods.

On Tannate of Bismuth, by M. Cap.[2]

Tannate of bismuth has been introduced in France as a remedy for obstinate diarrhœa. It is prepared by first precipitating the oxide of bismuth from a solution of 44 parts of the crystallised nitrate by means of an excess of strong caustic soda. The precipitate is collected on a cloth and carefully washed. It is then triturated in a mortar with 20 parts of pure tannin. The magma is then diluted with water, the whole is thrown on a cloth, washed, and then dried either in the open air or in a slightly heated closet.

The salt has a yellowish appearance; it is insoluble and consequently almost tasteless; it is easily suspended in a mucilaginous vehicle, in syrup, or in glycerine; and and can also be administered in the form of pills, or of an electuary.

[1] *Journ. de Pharm. et Chimie*, 23 Jan. 1860.
[2] *Répertoire de Pharmacie*, t. xvi. p. 241.

Its composition when thoroughly dry represents:

Oxide of bismuth	53
Tannin	47
	100

The above mode of preparation is very simple and at the same time the most rational. Most of the insoluble tannates are obtained by double decomposition; but the salts of bismuth and especially the nitrate, are in great part decomposed by water, and to keep them in solution it is necessary to have a great excess of acid, which, in the present case, would prevent the precipitation of the tannate of bismuth. It is better then to effect the combination directly, by acting on one equivalent of oxide of bismuth with one equivalent of tannic acid. The tannic acid may be dissolved in alcohol, ether, or even water, and then the tannin obtained in a resiniform mass can be used, which is cheaper than that obtained in the usual form.

The tannate is administered in doses of 30 grains.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, 3 *Feb.* 1860.

On the Mineral Treasures of the Andes, by Frederick Field, *Esq.*

I am very much afraid that after the lectures you have been in the habit of hearing at this Institution, the subject to-night will not prove very attractive. I have no experiments to show you, as the subject scarcely admits of experimental demonstration, and I think you will agree with me, that unless experiments serve to illustrate the truths advanced, they are of little value; when merely dragged in for the purpose of showing something pretty or amusing they are alike derogatory to the audience and the lecturer. May I claim your forbearance, then, this evening, I am lecturing here for the first time: I have been immediately preceded by two eminent philosophers, and I have only recently returned to England, after a long absence, from very distant lands. The great extent of country which lies between the Cordilleras on the east and the Pacific Ocean on the west is excessively rich in mineral productions, of which many are interesting not only as regards their commercial value, but also from their rarity and occasional novelty. It may be presumed that from the great extent of country, the difficulty of access in certain seasons of the year, as well as the comparatively few labourers in the field of science, that much still remains to be investigated. However, European enterprise and capital have done much in developing the resources of the country. The miner, finding a ready purchase in the smelter or merchant for the minerals he discovers, with an endurance scarcely conceivable, traverses mountain and valley, hill and plain, in search of new wealth, and when found, he makes his lonely habitation on some solitary summit where he remains often for months together, heedless alike of the silence or the storm. Of course in his travels he occasionally meets with minerals of which he has little cognizance, but from their metallic lustre, high specific gravity and other physical appearances, he deems them not wholly destitute of value. By exercising a little tact and discretion many new species can be thus obtained, for the miner, ever ready to know the marketable worth of the various ores he meets with, brings down for examination very curious minerals, especially to those who interest themselves in his labours.

In speaking to-night of the treasures of the Andes we shall confine ourselves particularly to the three metals and their compounds, which really constitute the chief wealth of that part of the world, viz. gold, silver, and copper. Copper,

at the first glance, may not appear so important as the two precious metals, yet in a commercial point of view it stands first on the list, many provinces in the northern part of Chile being mainly dependent for their support upon the various copper mines. There is an old adage in South America: "A gold mine must lose; a silver mine may lose; a copper mine must gain." This proverb does not always hold good, as many have been ruined in extracting copper, and many have made immense riches in searching for silver, but it simply implies that gold and silver are not generally found in such perfectly formed veins, or rather that the treasures in those veins occur in bunches, and then cease altogether for many yards, whilst copper generally continues throughout in more or less abundance.

We will divide the copper ores of the Andes into three classes:

1. Those destitute of sulphur, antimony, and arsenic.
2. Those containing sulphur, but free from antimony and arsenic.
3. Those containing sulphur, antimony, and arsenic, or the two latter without sulphur.

Native copper exists in considerable quantities, both in the higher ranges of the Cordillera and also comparatively near the coast. The province of *Andacollo* perhaps yields it in the largest quantity, and very often of considerable purity, although nearly all specimens contain traces of gold, antimony, arsenic, and silver. It occurs not only in large amorphous masses, but often beautifully crystallised in octahedra. It generally has a pure clear red colour, sometimes however whitish or of a brassy appearance. When this latter is the case it usually contains arsenic. *Red oxide of copper* is found associated with the native metal very often in large masses, but often in fine ruby crystals. Sometimes these crystals have a very dark colour, becoming almost black, but on crushing or filing, they afford the bright cochineal red powder so characteristic of the suboxide.

The black oxide was considered until quite recently a very rare mineral, occurring only ocasionally bordering the larger specimens of red oxide, but a discovery last August of a mine in the extreme north of Chile, has afforded splendid masses consisting essentially of the protoxide. This mineral has a very singular and novel appearance, resembling the fibrous variety of hornblende. Its analysis has not yet been published. Of the silicates of copper large quantities are found—the black, blue, and green. These ores, as may be supposed, are very hard to smelt, consisting entirely of silicic acid, oxide of copper, and water, but being perfectly free from antimony and arsenic, when well fluxed by the addition of suitable quantities of oxide of iron or lime, yield very pure copper. The black silicate is termed *metal aterciopelado* or velvet metal, from its deep black colour and soft feel and aspect. The silicates of copper are not found crystallised, but in masses more or less hard, according to the quantity of metal they contain; the harder the mineral the poorer it is in copper. The silicates often assume the botryoidal form; they are termed *llanca* by the Chilinos. A very interesting double silicate of manganese and copper occurs in Tambillos, and I have recognised the same mineral in other parts of South America. It is soluble in dilute hydrochloric acid, even in the cold, with evolution of chlorine, leaving a white residue of silicic acid. It is termed in Chile *metal de carbon*, from its striking resemblance to ordinary coal.[1]

The carbonates of copper are abundant, but no true malachite has yet been noticed, at least such as would bear comparison with that from Australia, Russia, or the west coast of Africa. It exists generally in amorphous and earthy masses, though sometimes finely crystallised in starry tufts of slender prisms. The blue carbonate is found occasionally very beautifully crystallised in the *Checo* mine, near Copiapo, but can hardly be considered an abundant mineral.

[1] The analysis of this mineral, as well as of others mentioned in the Lecture, are appended at the conclusion.

Phosphates of Copper.—Until lately the phosphates were unknown in the western part of South America, but have lately been discovered in the mineral district of Tambillos, consisting of 4 equivalents of oxide of copper, 1 of phosphoric acid, and 3 of water (*tagilite*); and 4 oxide of copper, 1 phosphoric acid, and 1 water (*liebethenite*). A very singular combination of phosphate of copper and lime, containing 2 atoms of phospho-calchite ($6CuO.PO_5.HO$) and 10 tribasic phosphate of lime, $10(3CaO.PO_5)$, with 1 chloride of calcium, occurs in fine bluish-green crystals, associated with apatite, in the same mine, from which the tagilite and liebethenite were derived.

Atacamite.—(Oxychloride of copper.)—This mineral is pretty extensively distributed through the northern parts of Chile, Bolivia, and Peru. Throughout all the district east of Copiapo it is found abundantly, and generally beautifully crystallised. It contains 1 atom of chloride, 3 oxide of copper, and 4 of water, although I have found 5 equivalents, and Berthier mentions a specimen from Cobija with 6 equivalents of water. A curious artificial formation of *atacamite* was observed in a large smelting establishment in Chile. The furnaces were connected with a large chimney by means of a horizontal canal or culvert running close to the seam. This culvert was built of brick, excepting the floor, which was simply the natural sand near the beach, and consequently impregnated with alkaline chlorides and sulphates. The finely-divived oxide of copper, resulting from previously calcined regulus, was blown by the draught from the furnaces into this chimney, and lodged on the floor. In the course of time layer after layer of dust was formed, so that the lower ones were protected from the flame, yet still were kept warm by the heat from above. The strata next the sand combined with some of its saline ingredients, and became converted into sulphate and oxychloride of copper, together with *brochantite* or subsulphate. Between 3 and 4 tons were formed in this manner.

Vanadiate of Copper, in association with vanadiate of lead, has been found in the Mina Grande in masses of considerable size. Rough analysis yields from 13 to 16 per cent. of vanadic acid.

In the second division of copper ores we have those which contain sulphur, or sulphur and iron. The disulphide or *copper glance*, Cu_2S, occurs often in a state of great purity, sometimes containing 79·4—79·6 of copper, with mere traces of iron. The protosulphide or indigo copper is generally intimately mingled with sulphate of lime. By powdering the mineral and digesting in cold water the sulphate is removed, and the residue is nearly pure protosulphide. The double sulphides of copper and iron are perhaps the most important ores in Chile, at least the greatest part of the copper derived from the Andes is extracted from this class of mineral. In the hill of Tamaya there exists an immense vein of the blue double sulphide, the purer specimens containing about 56 per cent. copper. Perhaps this mine (the *Pique*) is, not even excepting the celebrated Burra-Burra, the most prolific in the world. It belongs to one individual, and the fortunate owner, as may be supposed, derives an immense income from the sale of the ores. And it may be well here to speak of the Chile miner, a portrait of whom I have here dressed in his ordinary mining habiliments. He is capable of undergoing an immense amount of fatigue. The ascent and descent of mines, where there are few or no appliances of machinery, is never an easy task, but when burdened with two or three hundred weight of stone or metal it is peculiarly trying. And yet the miner, day after day, goes on with his employment, digging away at his work and carrying up the rock to the surface. In the year 1851 I begged Señor Urmeneta, the proprietor of some of the richest mines in Chile, to send me some specimens for the Great Exhibition, as samples of Chile mineral wealth. He immediately forwarded two large stones, one weighing 356 lbs. and the other 349 lbs., and he told me that perhaps the strength of the miner who excavated these masses and brought them from the mine was as striking as the richness

of the specimens themselves. Both stones had been taken from a depth of more than 300 feet, and had separately been borne on the shoulders of a man, he having to ascend, not by ladders or other aid, but by climbing up the nearly perpendicular slope of the mine. And the food the miner principally lives upon is an interesting subject for physiologists. He seldom takes meat, and when he has that luxury it is simply served out in long thin strips, which have been dried in the sun. His chief diet is the haricot bean, and without this nutritious vegetable he could never get through the work required of him. The beans are boiled until they are quite soft, and eaten with a little bread.

Guayacanite.—This mineral was obtained from a mine many thousand feet above the level of the sea, and consists entirely of sulphur, arsenic, and copper. I named it from the large smelting works of Guayacan, rather prematurely perhaps, as a mineral very similar had been previously discovered in Peru, and called *enargite*. The great distance I was from scientific friends, and the interrupted communication of books and periodicals, rendered it difficult for me, at most times, to know what was doing in other parts of the world. The mineral is interesting, as a *pentasulphide* of arsenic is in union with the disulphide of copper ($3Cu_2S + AsS_5$).

Domeykite, named in honour of M. Domeyko, professor of chemistry and mineralogy in the university of Santiago, contains 6 equivalents of copper to 1 of arsenic. Many years ago Mr. Faraday analysed a somewhat similar mineral, and the analyses were confirmed by Dr. Blyth in 1848. The substance these chemists investigated contained a certain portion of arsenious acid, whilst *Domeykite* is a simple union of the two metals.

Algodonite is another compound of copper and arsenic, named after the mine *Algodones*, from which it was obtained, It consists of 12 of copper and 1 of arsenic ($Cu_{12}As$).

I forgot to mention when speaking of the compounds of sulphur with copper, the two minerals *cyanose* and *brochantite* one the ordinary sulphate, the other a basic salt containing 4 atoms of oxide of copper to 1 of sulphuric acid.

Before referring to the silver minerals allow me to dwell for one moment upon this beautiful substance which we have before us, the bisulphate of sesquioxide of iron. It occurs in the mine near Copiapo in large nodules, each nodule being composed of numerous beautiful gold coloured fibres, radiating from a centre. It consists of $Fe_2O_3.2SO_3 + 10HO$, and is speedily decomposed by boiling water.

For a long time the chief place of export for the silver from Chile was the port of Coquimbo, a view of which is before you, but some five and twenty years ago an immense discovery of the precious metal was made in a very curious manner. A wood-cutter named Juan Godoy was benighted upon the hill of Chañarcillo, about forty miles from the city of Copiapo, and determined to rest there till morning. Having unsaddled his mule he kindled a small fire and lay down to rest. At early dawn he re-saddled his mule, and was upon the point of starting when he moved away with his foot the ashes left by the burning wood, in search of some embers, by which to light his cigarito. Immediately under the ashes he observed a shining metallic surface, and by means of his knife or other rude implement, he managed to extract a large lump of ore. Ignorant of its value, he brought it to Copiapo and showed it to a watchmaker, who told him it was lead, and offered him a dollar for the lump, at the same time telling him he would give him a similar sum for every piece of metal he might bring of the same kind as that which was now before him. Juan Godoy went backwards and forwards after this many times bringing lumps of the mineral to the artisan. He was watched, however, and soon the secret was discovered. He had hit upon a rich vein of silver, every piece he had excavated being nearly solid metal, which the watchmaker knew perfectly well. What was the sequel of Godoy's history I do not know. I believe he did not die in affluent circumstances, but he has had honours paid to his memory. A town has sprung up at the foot of the hill, where he, benighted, first found the ore which has since made others so wealthy, and is called after his mame, and his statue is erected in the chief square of the city of Copiapo. Since then more than ten millions sterling have been extracted, and what is very remarkable, although subsequent research has discovered numerous rich silver veins in the same hill, which is so pierced and honey-combed as almost to resemble a gigantic rabbit warren, no mine has equalled the one first discovered. Godoy kindled his fire upon the very richest vein in the whole hill, and from that time to the present day it has proved amongst its glittering neighbours to be the wealthiest and the best. Many interesting varieties of silver and its compounds have been found in Chañarcillo —the chloride, chloro-bromide, iodide, and bromide; the sulphide, light and dark *rosicler*, *polybasite*, &c. The native silver itself when associated with the chloride or chloro-bromide is nearly chemically pure; when found with the *rosicleres* it always contains arsenic or antimony.

It may be supposed that the immense treasures obtained in this province, raised the city of Copiapo to a state of considerable importance. The port from which the specie and ores were shipped was found to be altogether too exposed and inconvenient, and another one was opened more to the north, now the thriving *port of Caldera*. A railway was formed from thence to Copiapo, subsequently an extension line was projected to Pavillon, some twenty-two miles further east, and now there is a railway as far as Chañarcillo. What used to be only a very few years ago a long and troublesome journey is now accomplished in a few hours.

The silver mines in *Arqueros*, a few leagues from Coquimbo, yield the native amalgam *Arquerite* (Ag_6Hg). Domeyko has discovered no less than five different amalgams in Chile and Bolivia.

Mercury exists in considerable quantity, chiefly as cinnabar (HgS). *Mercurial fahlerz* is found in some mines, and the very rare mineral *ammiolite*, derived doubtless from the oxidation of the former. I obtained fine specimens from a mine near Andacollo, researches upon which have appeared in the *Journal of the Chemical Society*.

In conclusion, I have to thank you for your kind attention to what can necessarily have only been a rapid and most imperfect sketch of some of the mineral treasures of the Andes.

Analyses of various minerals from South America.

Red Oxide of Copper.
Cu_2O.

Black Oxide of Copper.
CuO.

Silicate of Copper.

CuO	50·10
SiO_2	28·20
FeO	2·70
HO	19·10

Silicate of Manganese and Copper.

CuO	27·00
MnO_2	34·41
SiO_3	22·16
HO	16·09

Double Phosphate of Lime and Copper.

CuO	20·98
PO_5	37·69
CaO	36·64
CaCl	2·33
HO	2·32

$2(6CuO,PO_5HO) + 10(3CaO,PO_5) + CaCl$.

Double Sulphide of Copper and Iron.

Cu	66·7	56·1	59·5
Fe	8·9	17·7	18·2
S	22·8	23·1	20·5
Matrix	1·6	3·1	1·8

Green carbonate of Copper.
$2CuO,CO_2,HO$.

Blue carbonate of Copper.
$3CuO,2CO_2,HO$.

Oxychloride of Copper.
$CuCl,3CuO,4HO$.

CuO	53·57
CuCl	30·35
HO	16·08

Tagalite.
$4CuO,PO_5,3HO$.

CuO	61·70
PO_5	27·42
HO	10·25

Libethenite.
$4CuO,PO_5HO$.

CuO	66·42
PO_5	29·31
HO	3·74

Domeykite.
Cu 6 AS.

Cu	71·82
As	28·18

Algodonite.
Cu 12 As.

Cu	83·61
As	16·39

The Rosiclers.

Light	$3AgS,AsS_3$
Dark	$3AgS,SbS_3$
Black	$4AgS,SbS_3$

Sulphide of Copper (with Sulphate of Lime).	
Cu . . .	57·91
S . . .	28·93
$CaO.SO_3$ . .	12·64

Disulphide of Copper.	
Cu . . .	79·4
S . . .	19·0
Fe_2O_3 . .	1·6

Amalgams.

Ag_6Hg

$Ag_7Hg_2 = Ag_6Hg + AgHg$

Ag_3Hg_2

$AgHg$

Ag_3Hg_4

$AgHg_2$

Native Gold (from Punitaqui).		
Au . .	91·62	86·60
Ag . .	7·79	13·20
Cu . .	·23	·04
Fe . .	·21	·16

Chlorides, &c. of Silver.
AgCl
AgBr
AgI
2 AgCl + AgBr
3 AgCl + 2AgBr
AgCl + 3AgBr

Guayacanite.	
Cu . . .	48·12
S . . .	32·98
AS . . .	19·00

Ammiolite.	
HgO . .	33·36
HgS . .	34·83
SbS_3 . .	14·92
SbO_3 . .	16·77

Native Gold (Andacollo).		
Au . .	91·80	96·00
Ag . .	7·85	3·10
Cu . .	·17	·16
Fe . .	·18	·13

SOCIETY OF ARTS, *Wednesday*, 15 *Feb.* 1860.

Figure Weaving by Electricity formed the subject of the paper read at this meeting of the Society of Arts, by the Secretary Mr. P. Le Neve Foster, who gave a most lucid and interesting description of the Jacquard loom, with the subsequent improvements of Riding, Barlow, Laforest and others, which however our limited space will not allow us to transcribe, so we will turn at once to the description of *M. Bonelli's Electric Loom*, the object of which is to supersede the present costly and complicated system of perforated cards, by an electro-magnetic arrangement of a highly ingenious character.

But Mr. Foster must now speak for himself: —

"In the first place it must be understood that the special object of M. Bonelli's machine is to do away with the necessity for the Jacquard cards used to produce the pattern at the present time, the source of delay and very considerable cost, more especially in patterns of any extent and variety of treatment. M. Bonelli uses an endless band of paper, of suitable width, the surface of which is covered with tinfoil. On this metallised surface the required pattern is drawn or rather painted with a brush in black varnish, rendering the parts thus covered non-conducting to a current of electricity. This band of paper bearing the pattern, being caused to pass under a series of thin metal teeth, each of which is in connection with a small electro-magnet, it will readily be conceived that as the band passes under these teeth, a current of electricity from a galvanic battery may be made to pass through such of the teeth as rest on the metallised or conducting portion of the band, and from such teeth through the respective coils surrounding small bars of soft iron, thus rendering them temporary magnets, whilst no current passes through those connected with the teeth resting on the varnished portions. Thus, at every shift of the band, each electro-magnet in connection with the teeth becomes active or remains inactive according to the varying portion of the pattern which happens to be in contact with the teeth. In a moveable frame opposite the ends of the electro-magnets, which, it should be stated, lie in a horizontal direction, are a series of small rods or pistons, as M. Bonelli terms them, the ends of which are respectively opposite to the ends of the electro-magnets. These pistons are capable of sliding horizontally in the frame passing through a plate attached to the front of it. When this frame is moved so that the ends of the pistons are brought into contact with the ends of the electro-magnets they are seized by such of them as are in an active state, and on moving the frame forward, those are retained while the others are carried back with it, and by means of a simple mechanical arrangement become fixed in their places; thus there is in front of the frame a plate, with holes, which are only open where the pistons have been withdrawn, and this plate, as will be readily understood, acts the part of the Jacquard card, and is suitable for receiving the steel needles which govern the hooks of the Jacquard in connection with the warp threads as ordinarily used.

Each shift of the pattern, combined with the backward and forward movements of the frame bearing the pistons, produces a different series of holes in the plate, which thus becomes what may be termed a universal Jacquard card, changing its face each contact, in accordance with the requirements of the pattern. Thus the electric loom gets rid of all those costly preliminaries which are required for the preparation of the cards, accomplishing instantaneously and automatically an analogous operation." When a pattern containing several colours is to be produced, "the design is prepared on the metallised paper, so that the coloured parts are represented by the metallised portion of the band, but each separate colour is, by removing a very thin strip of the foil at the margin, insulated from its neighbouring colour. Then all the pieces of foil thus insulated, which represent one colour or shade, are connected with each other by means of small strips of tinfoil, which pierce through the paper and are fastened at the back, and are conducted to a strip of tinfoil which runs along the edge of the band, there being as many such strips of tinfoil as there are colours. Thus each special colour of the pattern, in all its parts, is connected by a conductor with its own separate strip of tinfoil, and by bringing the wire from the pole of the battery successively into contact with the several strips, a current of electricity may be made to pass in succession through the several parts of the design on the band representing the separate colours of the design. Thus, assuming four colours, 1, 2, 3, 4, there would be four strips of tinfoil running the length of the band, insulated from each other, each of which would be in connection with its own separate colour only. At any given moment, the thin plates of metal resting on the pattern would touch it in a line which, as it passes over the width of the pattern, would run through all, or any one or more of the colours, but the electric current would pass only through those plates which rest on the one colour, represented by the strip with which the pole of the battery at that instant happened to be in contact."

We are forced to omit various interesting details relating to the electrical contrivances of this invention, but must pass on to the question of comparative expense, a not unimportant inquiry in a commercial point of view; here we are told that: —

"The electric power required for the loom is small, and that derived from two cells of a Bunsen's battery of ordinary dimensions is sufficient. The cost of this per day is calculated at not more than one penny.

It is thus that M. Bonelli gets rid of the cards, which we have seen are not only a source of expense, but of considerable delay as well, and by this system the operations are reduced to tracing the design on the metallised paper with a non-conducting varnish. The rest of the operations remain the same. The thin plates passing over, the pattern becomes as it were alive under the action of the electric fluid, feeling out the design and instantaneously and unerringly improvising for the moment the card required for the production of the design on the fabric.

The inventor claims the following as the results of his invention: —

1. The great facility with which in a very short time, and with precision, reductions of the pattern may be obtained on the fabric by means of the varying velocity with which the pattern may be passed under the teeth.

2. That without changing the mounting of the loom or the pattern, fabrics thinner or thicker can be produced by changing the number of the weft, and making a corresponding change in the movement of the pattern.

3. The loom and its mounting remaining unchanged, the design may be changed in a few minutes by the substitution of another metallised paper having a different pattern.

4. The power of getting rid of any part of the design if required and of modifying the pattern.

The length of paper required for a pattern depends, of course, on the nature and extent of it, but an idea may be formed generally by recollecting that at each stroke of the shuttle a card of the Jacquard apparatus is brought into operation, while in M. Bonelli's invention, the paper having the pattern moves at the rate of a fraction of a millimetre at each stroke. M. Bonelli gives the following calculations by way of comparison between the old and the new systems.

He takes a damask design on the old system, requiring 4000 cards, and with 400 Jacquard wires.

The cards will cost, at 12*s.* per hundred, 24*l.* The time employed for the *mise en carte* of the pattern, the reading it off, and punching 4000 cards, cannot be taken at less than about five weeks.

On the electric system, the executing the design on the metallised paper, ready for putting on the loom, he calculates at 6*l.* The time employed would be a week, showing a difference in favour of M. Bonelli's system, in this case, of 18*l.* in money, or 75 per cent. and in time of 80 per cent."

It is further stated that the electrical apparatus can be applied to any of the existing looms for about 20*l.*, an amount which seems quite insignificant when the cost of a single set of Jacquard cards is considered. At the conclusion of the paper an animated discussion took place, but being chiefly of a technical character, need not be reported in these columns. The new loom, together with many specimens of its powers, and several models and diagrams were exhibited. The thanks of the Society were unanimously voted both to Mr. Foster and the eminent and ingenious Sardinian.

CHEMICAL SOCIETY, 16 *Feb.* 1860.

PROFESSOR BRODIE, *F.R.S. President, the Chair.*

DR. GUTHRIE read a paper *On some Derivatives from the Olefines.* After referring to the bodies he had previously described, namely, $C_4H_4Cl_2S_2$, and $C_{10}H_{10}Cl_2S_2$, and $C_{10}H_{10}ClS_2$, he pointed out the mode of producing a new body, which he termed the bisulpho-chloride of chlorethylen. Dry pure ethylen was passed through boiling bisulphide of chlorine contained in a retort attached to a condenser, directed upwards so as to cause the flowing back of the distillate. The liquid was then heated in a smaller retort until the temperature rose to 180° C. The residue in the retort was washed first with water, then with dilute caustic soda, and afterwards purified by means of ether. Its composition was found to be $C_4H_2S_2Cl_2$, and its formation was described by the equation $C_4H_4 + 3S_2Cl = C_4H_3S_2Cl_2 + HCl + S_4$. Bisulpho-chloride of chlorethylen is a transparent liquid of light yellow colour, of a sweet pungent taste, and of a pepperment-like odour. It is soluble in ether and alcohol, insoluble in water. It is not volatile without decomposition. Its sp. gr. is 1·599. Dry chlorine gas was passed through bisulpho-chloride of chlorethylen until the heat first developed had abated, and subsequently for two hours at the temperature of 100° C. The product after purification was found to have the composition $C_4H_2Cl_2SCl$, and was denominated the chlorosulphide of bichlorethylen. It is a faintly yellowish transparent liquid, of a persistent suffocating smell, miscible with ether and alcohol, but not with water. It may be volatilised in a current of dry carbonic acid. Its sp. gr. is 1·225. Identically the same compound was obtained by passing chlorine through bisulphide of ethyl. The bisulpho-chloride of amylen $C_{10}H_{10}S_2Cl$, described in a former paper, was also subjected to the action of chlorine, and a product obtained whose analysis corresponded with the formula $C_{10}H_7Cl_3SCl$ chlorosulphide of terchloramylen. It is a transparent, non-volatile, pale yellow liquid of sp. gr. 1·406, and greatly resembling in its general properties the body last described. Dr. Guthrie also subjected amylen to the action of nitric acid. A current of air, charged with the vapour of amylen was passed through boiling strong nitric acid, whereby a fatty crystalline sublimate was condensed in the receiver. This after purification, and crystallisation from boiling ether, occurred in long rectangular prisms. By analysis it proved to be binitro-amylen $C_{10}H_8(NO_4)_2$. This body furnishes the first instance of a nitro-substitution product of an olefine. It is insoluble in cold and boiling water, nearly insoluble in cold but readily soluble in hot alcohol, soluble in ether and bisulphide of carbon. Heated by itself in a test tube, it is decomposed with explosive violence. Heated in the air it burns with a livid flame.

DR. ODLING pointed out the relations of Dr. Guthrie's products to the mercaptan series of compounds, thus:

$C_{10}H_{10}Cl_2S_2$ and $C_4H_4Cl_2S_2$ analogous to $C_4H_6S_2$ mercaptan.
$C_{10}H_7Cl_3S$ and $C_4H_2Cl_3S$ analogous to C_4H_5S sulphide of ethyl.
$C_{10}H_{10}ClS_2$ and $C_4H_3ClS_2$ analogous to $C_4H_5S_2$ bisulphide of ethyl.

DR. ODLING made a verbal communication *On the direct oxidation of chlorhydric acid.* When air charged with the vapour of chlorohydric acid was passed through a solution of permanganate of potassium acidulated with sulphuric acid and heated in a water bath, a liquid distillate was obtained free from any smell of chlorine but having the characteristic sweet smell of hypochlorous acid, $HCl\Theta$. It had a feeble acid reaction, and possessed bleaching properties which did not disappear upon keeping the liquid for an hour at the temperature of 100° C. After evaporation to a small bulk, and neutralisation with caustic potash, it yielded crystals of chlorate of potassium. The author represented the acids of chlorine as follows, and considered the oxygen acids as oxydised compounds of chlorohydric acid.

HCl	Chlorhydric	Acid.
$HCl\Theta$	Hypochlorous	,,
$HCl\Theta_2$	Chlorous	,,
$HCl\Theta_3$	Chloric	,,
$HCl\Theta_4$	Perchloric	,,

CORRESPONDENCE.

Chemical Nomenclature.

To the Editor of the CHEMICAL NEWS.

SIR, — In glancing over some of the recent numbers of the CHEMICAL NEWS, I observed a passage of yours in reply to a correspondent, *A. P. S.* in No. 6, p. 72, which I think requires further elucidation at your hands. You say that being "better acquainted with the recent literature of chemistry, he (*A. P. S.*) would find no difficulty in the terms nitrate of *potassium*, chlorate of *barium*, &c. to which he alludes." I can say that all the manuals that have come to my hands — Kane, Brande, Graham, Miller, Gregory, &c. give no explanations that would lead any student to infer that the names above referred to, indicated the compound, $KNO_6 = KO.NO_5$ or $BaClO_6 = BaO.ClO_5$. They do explain, and advocate the propriety of attributing to the hydrogen of such acids as hydrochloric, sulphuric, nitric, phosphoric, and other similarly constituted acids the power of acidification rather than to the other components; also the consistency of having not *two* classes of acids and *two* classes of salts — such for instance as the hydracid and oxacid salts — but one class of acids, and one of salts, the nomenclature of which should not exhibit such inconsistent diversity as the system of nomination and representation of the preceding classes as hitherto practised manifest.

If in the new system of formulæ tabulation you assume for the positive element, hydrogen in the acid $HO.NO_5$ or HNO_6 — nitric acid — the acidifying power, and make the other elements, NO_6, a compound radical, serving merely to give a distinctive character to the assumed functions of the H, I think you should adopt some other term to express the compound, $H.NO_6$, besides the hackneyed name *nitric acid*; and this is also the case when a salt of such an acid is spoken of. Besides, the manuals state that, as a rule, *simple* bodies combine with such, and copulated bodies with others similarly constituted in forming compounds, excepting

where a copulated or compound body exhibits properties entirely analogous to the simple substance or element. Now if you do not adopt a name for the nitric acid, as represented in the preceding instance, expressive of the fact that the NO_5 has functions in the salt KNO_6 analogous to those of Cl in the compound KCl, I think it is too much to expect that students who may not be very far advanced in the science will comprehend what sort of a compound is meant, when you retain the old name for the acid — thus giving the idea that the anhydrous or combining radical NO_5 is indicated — and combine it with a salt-base or metal potassium K, calling the resulting compound by the incongruous name — *nitrate* of *potassium*. I think you would be doing a great service to chemistry if you advocated a consistency in the symbolic representation of chemical bodies and in their titles. If, for instance, the compound $KO.NO_5$ or KNO_6 were called instead of *nitrate* of *potassa* or *nitrate* of *potassium*

	Nitratide of potassium
KSO_4 (sulphate of potassa)	Sulphatide of „
K_3PO_8 (phosphate of potassa)	Phosphatide of „

and so on through all the higher oxygen compounds of acid and base, I think it would be much simpler, and the names would not be unnecessarily or inconveniently lengthened, at the same time that a unique analogy of the title and composition of all the salts would be secured.

In the same way the compound $KO.NO_3$, or KNO_4 instead of *nitrite* of *potassa* or *nitrite* of *potassium*, could be named

	Nitronide or Nitritide of potassium
KSO_3 (sulphite of potassa)	Sulphitide of „
K_2PO_6 (phosphite of potassa)	Phosphitide of „

Certainly every experienced chemist would not fail to comprehend what substances were referred to in the paragraph in No. 3, p. 36 of your journal, to which doubtless your correspondent *A. P. S.* alluded, but the propriety or expressiveness of the names given to those compounds in said paragraph, deserve, in my opinion, no thanks for it.

Hoping to see you using your influence with your numerous patrons to place this and similar questions on a more consistent and unalterable foundation; and wishing you every success in your career, — I am, &c.

YOUR WEEKLY GUEST.

The Cavendish Society.

To the Editor of the CHEMICAL NEWS.

SIR,—The annual meeting of the Cavendish Society is to take place as usual on the 1st of March. What is transacted at these meetings we only know by the short reports issued by the council. Whether any subscriber ever attends to complain of the slowness with which the Society's books are published, and of the way the council have of making promises and never keeping them, I do not know. I do not attend the meetings myself, but I am anxious before the next takes place to call the attention of the subscribers to one or two facts.

The society was started in 1848, and in their first report the council proposed a list of books which they thought it would be desirable to publish. Among them was Persoz' *Art and Theory of Calico Printing*; Essays by Saussure and others on *Vegetable Chemistry*; Rammelsberg's *Dictionary of the Chemical part of Mineralogy*; Kopp's *History of Chemistry*; Otto's *Economic Chemistry*. Afterwards were announced a volume of *Chemical Essays* on many subjects; Plattner on the *Roasting of Ores*; and last, but not least, Rose's *Analytical Chemistry*. Of these works not one has been issued, although two of them—the Essays by Saussure and Rose's work—have been announced as in progress. In the course of the eleven years, however, twenty-two volumes have been published, which at the rate of 10*s*. 6*d*. each to the subscribers cannot be considered cheap, especially for some four or five of them. It is true that the great value of Gmelin's work will compensate for much, but I do not see why the Cavendish Society should degenerate into a society for the publication of *Gmelin's Chemistry*. If the council do not intend to publish anything else, why do they not tell the subscribers so, finish the book at once, and let the Society die? The old Sydenham Society, which expired some time ago, has been reanimated with considerable success. If the Cavendish underwent the same process perhaps something better might be done for chemical literature.—I am, &c.

A SUBSCRIBER TO THE CAVENDISH SOCIETY.

Manchester, 22 Feb. 1860.

The Atomic Theory.

To the Editor of the CHEMICAL NEWS.

SIR, — In the number of the CHEMICAL NEWS for February 4th, 1860, I observed an argument for the atomic theory; based on the circumstance that the attraction between spheres which touch one another varies as their radii. From this it was argued, that indivisible atoms must exist; for if not, we might divide matter, until we should have portions whose radii = 0; and therefore there would be no attraction.

But, if this law of attraction be true, it must likewise be true for any size of sphere, and therefore for a sphere infinitely small. We could never divide matter to such an extent that the portions would have *no* diameter. The question of attraction is mathematical; and is distinct from any theories of the nature of matter.

Besides the objections that I put forward a short time ago, under the name of (GIMEL) a few others might be mentioned. For instance: the atomic theory does not assign any *properties* to the atom itself. It can have no *colour*, for colour relates to a number of atoms, influenced by a vibratory motion. It (*i. e.* the atom) cannot be spoken of as transparent or opaque. Transparency is a question of an undulation in or rather pervading the space between the particles of a body. It cannot be hard or soft. These properties depend on the amount of motion that can take place among the particles. It can have no weight; for the attraction is supposed to exist exterior to the atom. The only property it can have is size. It is difficult to imagine anything to have size and nothing else; size in the abstract can scarcely exist. So that we are almost obliged to admit that the atom cannot exist. — I am, &c.

A. REYNOLDS.

The Patent Medicine License.

To the Editor of the CHEMICAL NEWS.

SIR, — While the Budget is under consideration, I should be glad if you would call attention to the unfairness of the present charges for the license to sell patent medicines. We London druggists pay 2*l*. for this license; in other cities and boroughs they pay 10*s*. and in other places 5*s*. Now it is just where the license is charged least, that the most patent medicines are sold. In London (except at a few large houses in that special line who might be made to pay more) very few are sold. And yet we are made to pay eight times the sum for a license that a man pays who makes a good profit on the sale. I would suggest that the duty should at least be equalised, or that the larger sum should be charged where the most profit is made. In London there are only about 1000 druggists, not half of whom I believe take out the license. In the country there are about 20,000, who almost all take a license, and a good number of grocers besides.

I do not wish to see the country druggists charged the higher sum, although in fairness I think they ought to be; but I do contend that the London druggist (except the wholesale and special houses) should only be made to pay the lower.—I am, &c.

A LONDON DRUGGIST.

To the Editor of the CHEMICAL NEWS.

SIR,—In your number of the CHEMICAL NEWS of last week, in your report of a meeting held at Hanover-Square Rooms, I am represented as having said, "Bread food he considered especially bad—opium was as innocent, and less troublesome." What I intended to say was, "that aluminised bread food was as sure a poison as opium, or any other poison if long persisted in," and shall be obliged to you to make this correction in your next.—I am, &c.

C. H. J. ROUTH.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Action of Soluble upon Insoluble Salts; Special Affinity of Phosphoric Acid for the Sesquioxides.—M. Guinet[1] shows that an insoluble phosphate of protoxide is completely decomposed by a soluble salt with a sesquioxide base, either cold or by boiling: the phosphate of the sesquioxide is precipitated.

Phosphate of Cobalt and Potash Alum.—The reaction is completed by boiling in less than an hour: the phosphate of cobalt, which is of a violet-red colour, is decomposed to form the colourless phosphate of alumina which is precipitated.

Phosphate of Cobalt and Chrome Alum.—The green solution becomes rose coloured after boiling for a few moments, and phosphate of chrominm is formed.

Phosphate of Cobalt and Iron Alum.—The decomposition is completely effected in a few minutes in the cold.

Other salts of the sesquioxide may be taken as well as the alums, and the author has verified the experiment with very different salts: the nitrate of iron, the tartrate of iron and potash, &c.

The phosphates of nickel and silver behave in the same way as the phosphate of cobalt, as does the phosphate of copper; but with the last the double decomposition takes place very slowly.

II. ORGANIC CHEMISTRY.

Crystallised Guaiacum Resin.—Prof. Hlasiwetz[2] has, after a long trial, found a way to change the greater part of guaiacum resin into crystals. He dissolves a pound of the resin in as much alcohol as will make a solution of the consistence of a thin syrup. This he strains through fine linen, and adds gradually, while still warm, half a pound of caustic potash in spirit, shaking them together. The whole is allowed to stand in a bottle about 24 hours. The magma obtained is then transferred to a strong linen cloth, and the fluid part carefully pressed out. The moist cake is washed with strong alcohol until the the alcohol runs away but slightly coloured. The mass is again pressed, then triturated with a small quantity of water, and afterwards heated in a dish until reduced to an uniform consistence. It is then transferred to a filter and washed with cold water until the salt is white, and the water runs away colourless. This potash salt (which is but slightly soluble in alcohol and water) may be obtained crystalline by dissolving it in a large quantity of dilute alcohol at the boiling point. From such a solution, as it cools, crystalline flakes separate. By cooling it very slowly larger crystals may be procured, which when dried have a pearly lustre. A second crystallisation gives them of a dazzling whiteness. From a solution of this salt in hot potash water, hydrochloric acid separates the resin. Immediately after the decomposition the resin is fawn coloured, soft, and sticky; it is washed with water, dissolved in alcohol, and the solution is allowed to evaporate spontaneously. By degrees it crystallises completely. The crystals appear scaly, or are aggregated together, have a pearly lustre, and a slight but most agreeable smell like vanilla.

They dissolve in ether, warm acetic acid, and dilute potash ley, but are insoluble even in warm ammonia water. Sulphuric acid dissolves them, acquiring a purple colour. The alcoholic solution gives with perchloride of iron an intense, beautiful green colour. Chloride of acetyl gives a substitution product, which may be obtained from an alcoholic solution in granular crystals.

It should be remarked that with this ingredient the blue reaction of tincture of guaiacum with oxidisable substances is not obtained.

From a mixture of the solution of the crystallised resin with a spirituous solution of soda a soda salt is precipitated, which may be purified like the potash salt.

Reactions of the Tincture of Guaiacum.—M. H. Schiff[3] observes that when iodine is added to the tincture of guaiacum, no coloration, or at most a dirty green colour, is seen. It is only on the addition of water that the liquid turns blue. Neutral salts do not interfere with this result; but a drop of acid is sufficient to hinder it. The blue colour produced by perchloride of iron is changed to violet by hyposulphite of soda, but this colour soon disappears, leaving a colourless liquid. The solution obtained by digesting zinc with sulphurous acid also decolorises the tincture blued by perchloride of iron.

The tincture may be employed to discover the presence of nitric in sulphuric acid. It is only necessary to heat the suspected acid in a tube with a few iron filings, and to pass the gas disengaged into the tincture of guaiacum, which is immediately turned blue if the gas contain any hyponitric acid. The resin of guaiacum dissolves in concentrated sulphuric acid, colouring it red; water causes a violet precipitate from the solution.

Mixtures of Ether with Water and Alcohol.—M. H. Schiff[4] shows that a saturated aqueous solution of ether at 54° F. has a density of 0·983.

Alcoholic solutions of ether gave him the following results:—

Alcohol.	Density.
0 per cent.	0·729
10 „	0·737
30 „	0·756
40 „	0·765
60 „	0·779
70 „	0·786
90 „	0·801
100 „	0·809

These values correspond with the formula

$$D = 0{\cdot}729 + 0{\cdot}000966\,p - 0{\cdot}00000222\,p_2,$$

in which p represents the weight of the alcohol.

III. CHEMICAL ANALYSIS.

Estimation of Titanic Acid in Silicates.—Scheerer[5] remarks that very many silicates contain small quantities of titanic acid, which hitherto has been overlooked. When a silicate is decomposed in the ordinary way, by acids or carbonate of soda, the greater part of the titanic acid is found in the precipitate obtained by adding ammonia to the solution filtered from the silicic acid; but some remains with the silicic acid. To separate this, the latter is treated with fluoric and sulphuric acids, and the residuum is added to the precipitate, which has been previously ignited. The united mass, in which, besides titanic acid, alumina, oxide of iron, manganese, and some lime and magnesia may be present, is fused with bisulphate of potash, the temperature being gradually raised until the greater part of the sulphuric acid in excess is dissipated. The fused mass is then dissolved in a large quantity of water, and sulphuretted hydrogen is passed through until the peroxide of iron is reduced to protoxide. After this the solution is boiled, and the fluid being kept hot, carbonic acid is passed through.

[1] *Comptes-Rendus*, t. xlix. p. 454.
[2] *Annalen der Chemie und Pharmacie*, Bd. cxii. s. 183.
[3] *Ibid.* Bd. cxi. s. 372.
[4] *Ibid.* s. 373.
[5] *Ibid.* Bd. cxii. s. 178.

The bases remain in solution while the titanic acid is precipitated.

Detection of Fusel Oil in Spirit of Wine.—Chloride of calcium in small pieces is put into a beaker, and just enough of the suspected spirit is poured over to moisten the whole; the beaker is then covered with a glass plate and allowed to stand. In a short time, if fusel oil be present, the smell will be distinctly perceptible, and will become stronger and stronger on standing for some hours. In this way the least trace of fusel oil can be recognised; but when the quantity present is very small, the mixture must be left together longer before the experimenter smells it, and then the nose must be applied frequently at short intervals.

The impossibility of recognising small quantities of fusel oil in spirit depends upon the insensibility of the olfactory nerves produced by the vapour of alcohol. If we wish to smell fusel oil alone we must prevent alcohol vapour from rising; this is best done by mixing the alcohol with chloride of calcium, which fixes it. Fusel oil also combines with chloride of calcium, but the combination is not odourless, while the alcohol is held so fast that it does not disturb the smell of the fusel oil.[6]

IV. TECHNICAL CHEMISTRY.

Application of Mineral Oil for the Lubrication of Watches, &c.—The finest animal and vegetable oils are found after some time to act on and oxidise the metals; Dr. Artus[7] has therefore tried to find a substitute for them free from the above objection. Mineral oil purified in the following manner he has found to answer the purpose well. First of all the oil is to be shaken with saturated chlorinated soda, and allowed to stand. The supernatant oil is then poured off and shaken repeatedly with milk of lime and allowed to become clear. The oil is again separated and then mixed with one third of its volume of a strong solution of soda and subjected to rectification. Many trials of this have been made by mechanicians, who speak strongly in favour of it.

Purification of Paraffin.—Those paraffins which do not become clear, and remain too soft after purification with sulphuric acid, P. Wagenman[8] of Neuwied recommends to be melted with a small percentage of oleine, then to be pressed while warm, and afterwards boiled with a weak alkaline ley. He treats it with 5 or 10 per cent. of oleine, and as this does not dissolve paraffin, the mineral oil and the oleine only are removed by pressure. The mixture of mineral oils and oleine is distilled with superheated steam. The mineral oils distil at 220°, and oleine at 280°.

LABORATORY MEMORANDA.

Lime-determinations.—To avoid the inaccuracy and loss of time nearly always resulting from the ordinary method of determining lime, viz. by strongly heating the precipitate of oxalate of calcium, and converting the same into carbonate by repeatedly moistening with solution of carbonate of ammonium, I am in the habit of weighing the precipitate as *sulphate* instead. The addition of sulphuric acid or even of sulphate of ammonium *alone*, to caustic lime is hardly a safe operation, in an analytical point of view, if the mass in the crucible is at all bulky, but the solution I am about to recommend may be employed without inconvenience for the purpose indicated above. Three parts of pure *liquor ammoniæ*, of the ordinary strength should be just neutralised with pure sulphuric acid (previously diluted with its bulk of water), and the two parts of the ammonia-solution added. In each ounce of the fluid thus obtained 10 grains of chloride of ammoniun must be dissolved; the whole may then be filtered into a small reagent-bottle and appropriately labelled. It must of course entirely volatilise when heated on platinum foil. In this manner the lime is weighed as *sulphate* which may be strongly ignited without change, *one weighing* therefore being sufficient.—*Wentworth L. Scott.*

[6] *Polytech. Centralblatt*, 1859, s. 1627.
[7] *Ibid.* s. 75. [8] *Ibid.* s. 75, 76.

Estimation of Mixtures of Acids or Alkalies in Solution. — In the Chemical News, No. 9, p. 108, under the head "Laboratory Memoranda," there is a method proposed for analysing a mixture of acids or alkalies by saturation with two or more alkalies or acids; as I am unable to see that there is a any advantage or reason in the process, I send an equation which will really give the required result, if there is nothing else present besides the mixed acids or alkalies, or the quantity of other impurities is known. Let X and Y be the quantities of the two substances present in a known weight of mixture, then:

$$X = \text{Eq. of X} \left\{ \frac{\text{Wt. of mixed acids or alkalies} - \text{Eq. of Y} \frac{\text{Quant. acid or alkali saturated}}{\text{Eq. acid or alkali}}}{\text{Eq. of X} - \text{Eq. of Y}} \right.$$

The equivalents must in each case be taken which correspond to 1 Eq. of NaO, or 1 Eq. of $HO.SO_3$: thus, sulphuric acid = 49, tartaric acid $\frac{150}{2}$, and citric acid $\frac{192}{3}$.

Under the head "Correspondence," in the same Number, there is a supposed proof of the non-existence of indivisible atoms, resting on a misapprehension of the use and value of infinity.—*John Morland, F.C.S.*

MISCELLANEOUS.

Sale of Poisons. — In the House of Commons on Tuesday the 21st inst. Mr. Clive obtained leave to bring in a bill to regulate the sale of poisons.

Metropolitan Board of Works. Contract for Perchloride of Iron. — The Metropolitan Board have advertised, as will be seen on reference to our front page, for tenders to supply perchloride of iron for deodorising purposes during the summer months of the present year. The perchloride supplied is not to contain less than 1lb. of iron per gallon, corresponding to 2 lbs. 14½ oz. of perchloride and not more than 1 oz. per gallon of free hydrochloric acid. The quantity to be delivered per diem within the Metropolitan area is 5000 gallons or thereabouts, and as much more if necessary on receiving three weeks notice that it will be required.

Substitute for Gutta-Percha.—According to Dr. Kirr, when the bark of the linden is boiled for some time in water it becomes soft, supple, and susceptible of taking all kinds of forms, which it preserves on becoming hard by cooling. This property it preserves after having been used, so that it can be used again for different purposes; according to this, the bark of the linden may be to a certain extent substituted for gutta-percha.—*Annales Méd. de la Flandre Occident.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

E. C. C. Stanford—The Fitzmaurice Light Company have an office in King William Street, E.C.

C. M. Dick.—We shall be glad to hear more on the subject; but we doubt whether our correspondent is right as to the cause of flour heating and souring.

M. W. H.—Forty cells of Grove's battery. It is convenient to have a lantern with an arrangement for adjusting the carbon points.

J. M.—Mr. Hancock vulcanises in several ways. Sometimes he dips the rubber compound into melted sulphur; at other times he sifts sulphur on to the sheets before curing, or he mixes it with the French chalk, and sometimes he mixes sulphur with the solvent.

Phosphate.—1. Impossible, we believe. 2. A soluble alkaline silica can be made by fusing sand with an alkali.

Excelsior.—It is said to be a consequence of catalytic action.

W. J. J.—1. The preparation of chlorodyne is kept a secret. Its use is as an antispasmodic and sedative. 2 Cyanide of potassium will take nitrate of silver stains out.

John Godwin.—We fear it will be impossible to do what our correspondent wishes. It would need a large book, and would be, in fact, a manual of chemistry.

E. H. (York) — *W. S.* (Hanley) — answers next week.

Thomas Salter, F.C.S. — *J. B.* — received.

Mr. F. W. Griffin's book has been received, and will shortly be reviewed.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London E. C.

THE CHEMICAL NEWS.

VOL. I. No. 13. — March 3, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Organo-metallic Radicals, by M. AUGUSTE CAHOURS.

(*Continued from p. 135.*)

Action of Magnesium on the Iodides of Ethyl and Methyl.—Magnesium, like zinc (which it resembles in many respects), appearing only able to form a single stable grouping of the form MgX, ought only to form a single compound with ethyl and methyl, and experiment shows that such is really the fact. If we place some filings of magnesium in a long and stout glass tube of small diameter, and pour on the metal a few cubic centimetres of iodide of ethyl, a lively reaction ensues, accompanied by a notable elevation of temperature. The action is moderated by affusions of cold water, and when the tube returns to the temperature of the air it is sealed, placed in an oil bath, which is heated to between 120° and 130° C. and the temperature kept within these limits for some hours. A solid white mass is then found in the tube composed of iodide of magnesium, some unaltered iodide of ethyl, and finally a colourless, very volatile liquid, possessing a strong alliaceous odour, which takes fire in the air, and decomposes water with violence when thrown upon it. To separate this substance from the rough product, the contents of the tube are introduced into a small retort previously filled with hydrogen, and distilled at a moderate heat. The iodide of ethyl and the new substance pass over while the earthy iodide remains behind in the retort. By properly managed rectifications of the distillate the inflammable product can be separated from the excess of hydriodic ether. The analysis of the liquid gave the following percentage results:

			Theory.	
C	54·54	4C	24	58·53
H	11·42	5H	5	12·19
Mg	„	Mg	12	29·28
				100·00

The error in the carbon and hydrogen observed in this analysis depends upon the presence of a small quantity of hydriodic ether, of which it is almost impossible to deprive the product. I redistilled the same liquid in a current of hydrogen, and after rejecting the first that came over, the new specimen yielded:

Carbon	55·20
Hydrogen	11·50
Magnesium	—

Here, as in the preceding analysis, the carbon and hydrogen are in excess; but the behaviour of the product with water, its mode of formation, and the manifest analogies with zinc ethyl which it presents can leave no doubt as to its real formula. It corresponds with the oxide of magnesium, ethyl replacing the oxygen.

Iodide of methyl behaves with magnesium just in the same way as the iodide of ethyl: the action is lively; heat is evolved, and a white mass is formed which by distillation is separated into iodide of methyl, and a strongly-smelling mobile liquid, inflammable in the air and decomposing water with the disengagement of marsh gas, separating at the same time flakes of magnesia.

By the action of magnesium on iodide of ethyl, a large quantity of gas is produced. Some of this is absorbed by bromine with the formation of bromated Dutch liquid. The part on which bromine does not act can be partially liquefied by exposure to extreme cold, and the observations of Frankland seem to show the presence of some carbide of hydrogen, C_8H_{10}. The action of magnesium on iodide of ethyl then is exactly like that which zinc exerts on this ether, and may be formularised in a similar manner.

$$C_4H_5I + 2\,Mg = C_4H_5Mg + Mg\,I.$$

$$2\,(C_4H_5I) + 2\,Mg = 2\,Mg\,I + C_8H_{10}$$

$$C_8H_{10} = C_4H_4 + C_4H_6.$$

Aluminethyl.—Aluminium in the cold exerts no action on iodide of ethyl: at the temperature of 100° C. however, the attack becomes very manifest, and by maintaining the mixture for 24 hours at 130° in sealed tubes the reaction is complete. Thick white vapours are seen at the commencement, the metal gradually disappears and a viscous liquid is obtained which fumes abundantly in the air. The contents of the tube placed in a retort filled with hydrogen and distilled yields a colourless liquid with a penetrating disagreeable odour, which presents some analogy with altered oil of turpentine. It fumes in the air, and decomposes water with an explosion, producing alumina and hydriodic acid, as well as an inflammable gas which burns with a pale blue flame. It boils between 340° and 350° C. It contains aluminium, iodine, and carbon and hydrogen in the proportions which constitute ethyl. On analysis, the product gave results which agree with the formula:

$$C_{12}H_{15}Al_4I_3 = Al_2I_3.Al_2(C_4H_5)_3, \text{ or,}$$

12C	72·0	13·78
15H	15·0	2·86
4Al	54·4	10·38
3I	381·0	72·98
	522·4	100·00

When this liquid is allowed to fall drop by drop into a bottle of chlorine or oxygen, it immediately takes fire and burns with a violet flame. The combination belonging to the same type as alumina, we may consider it as formed of an equivalent of iodide of aluminium with an equivalent of aluminethyl. Zinc ethyl attacks it quickly and there is formed the iodide of zinc, and a very inflammable liquid which is probably *aluminethyl*. The iodide of methyl behaves with aluminium just as the iodide of ethyl. A colourless liquid is produced which contains aluminium, iodine and the elements of methyl. Like its ethylated homologue this compound burns in the air, and quickly decomposes water, forming the hydride of methyl.

Glucinium acts strongly on the iodide of ethyl when heated with this liquid in sealed tubes. As in the former cases a solid substance is obtained, which by distillation furnishes a liquid having the power of decomposing water with the disengagement of an inflammable gas; the mode of action appears analogous to that of aluminium.

Stannethyls. — Tin foil is rapidly attacked by hydriodic ether in sealed tubes at a temperature of 140° to 150°. At the latter temperature, by employing 2½ or 3 parts of iodide of ethyl to 1 of tin, the reaction is completed in from 20 to 30 hours. When the tubes are cold, we find in them two sorts of products — a white substance crystallised in long needles and a yellowish mobile liquid — the tin has entirely disappeared. The liquid poured from the crystals again deposits magnificent crystals like the preceding. These are removed with care, and when the liquid deposits no more, it is carefully distilled in a retort furnished with a thermometer. It begins to boil towards 72° or 75°, when the unaltered hydriodic ether passes over. The thermometer soon rises to 230° and remains there a short time. At this temperature an amber-coloured liquid with a very irritating odour passes; then the thermometer rapidly mounts to 245°. The temperature then remains constant, and the product gathered in the receiver solidifies by cooling into a white mass formed of needles crossing one another. The reddish crystalline matter, a very small quantity of which remains in the retort, is iodide of tin. The crystals withdrawn from the tubes and those deposited from the liquid dissolve in warm alcohol, separating on evaporation in beautiul colourless prisms, which are completely deprived of smell by squeezing in blotting paper and recrystallisation. These crystals at 42° melt into a colourless very limpid liquid, which boils between 245° and 246° C. Cold ether dissolves them easily. They are very slightly soluble in cold water, but more so in boiling. The alcoholic solution is immediately decomposed by the sulphate, nitrate, acetate, &c. of silver, forming iodide of silver, and the corresponding salts of the oxide of stannethyl. Ammonia decomposes the alcoholic solution, giving a white amorphous precipitate of oxide of stannethyl, which dissolves in an excess of the precipitant. Oxalic acid and the oxalates form white precipitates. Cyanide of silver gives iodide of silver, and the iodocyanide of stannethyl which remains dissolved in the alcohol and forms on evaporation a crust of crystalline appearance.

When iodide of stannethyl is heated in sealed tubes with its weight of iodine, it is completely decomposed, and the red iodide of tin and hydriodic ether are formed.

$$C_4H_5SnI + 2I = SnI_2 + C_4H_5I.$$

The analysis of the colourless prismatic crystals removed from the tube and purified by several recrystallisations gave results which agree with the formula, C_4H_5SnI.

4C	24·0	11·16
5H	5·0	2·32
Sn	59·0	27·45
I	127·0	59·07
	215·0	100·00

There is formed then by the reciprocal action of tin and the iodide of ethyl, the crystallised iodide of a ternary radical containing carbon, hydrogen and tin, which I shall call stannethyl, a radical which can be eliminated by the intervention of a more electro-positive metal.

Action of Alloys of Tin and Sodium on Iodide of Ethyl. — After having examined the action of pure tin on iodide of ethyl, I propose to study that of a series of alloys of tin and sodium on the same product. The experiments of Wurtz have shown that pure sodium splits up the iodide of ethyl into an alkaline iodide, and a carbide of hydrogen, C_8H_{10} (ethyl), which has been improperly considered as the radical of the ether derivatives of alcohol. Knowing the action of these metals taken separately, it is interesting to see how their alloys behave.

I commenced with an alloy of 98 parts of tin and 2 parts sodium. This alloy had some malleability, but broke on repeated strokes of the hammer. It had no action on the iodide of ethyl in the cold, but heated to 130° C. the decomposition was completed in 20 or 25 hours. As with pure tin, a large proportion of iodide of stannethyl was formed, but with a larger quantity of an irritating oil with a mustard smell, only a small quantity of which is obtained with pure tin.

An alloy of 95 parts tin and 5 of sodium (which can be pulverised) was not immediately attacked by iodide in the cold; by prolonged contact it was acted on. At 130° C. the action was completed in some hours, with the formation of the same bodies as before, but a larger amount of the oily matter with the mustard smell. In both these cases analysis proved that the crystallised matter was iodide of stannethyl.

The oily matter carefully rectified gave two products: a colourless liquid with an etherial odour, which boiled about 75°, a strongly smelling liquid, which boiled between 230° and 240°, and lastly, crystals of iodide of stannethyl. I have not analysed the product which boiled at 75°, all its properties showing that it was hydriodic ether. The other liquid after 2 or 3 rectifications had a constant boiling point, between 234° and 236°. It was a perfectly definite compound, whose analysis agreed with the formula $(C_4H_5)_3Sn_2I$. This liquid then is the iodide of a new radical, corresponding to the oxide Sn_2O_3, and represented by the formula Sn_2E_3.

An alloy of 92 parts tin and 8 parts sodium (which is easily pulverised) is not immediately attacked by the iodide of ethyl; but after some minutes heat is evolved, and the penetrating odour of iodide of stannethyl is perceived. When the mixture had cooled, I placed it in stout tubes, sealed them, and heated to 140° for 24 hours. Two of the tubes having been broken, only a small quantity of gas was given off, but a third flew to pieces. The liquid part of the contents of the tubes was an amber coloured limpid fluid, which began to boil about 200°, and the greater part of which distilled between 235° and 245°. This last portion, deposited crystals of iodide of stannethyl. The first portion carefully rectified between 235° and 238°, also proved to be iodide of stannethyl.

An alloy of 90 parts tin and 10 parts sodium is quickly attacked by iodide of ethyl, even cold, with the formation of a volatile liquid, having a mustard smell. When, however, no action takes place in the cold, the mixture may be heated to 140° for 24 hours. The tubes having been broken, the residue is exhausted with anhydrous ether. The etherial solution evaporated on a water bath leaves as residue a yellowish oil, which swims on a viscous substance of a deeper colour. The oil when rectified gave a pale amber coloured liquid, which boiled between 235° and 238°, and which analysis proved to be the iodide of sesquistannethyl.

Eighty-eight parts of tin and 12 sodium form a crystallised alloy which is quickly acted on by hydriodic ether. The mixture heated for 18 to 24 hours, to 130°, in sealed tubes as before, yields a yellowish brown mass. On

treating this with a mixture of alcohol and ether, and evaporating the solution, a slightly coloured oil is obtained, with an orange coloured viscous mass, in which a few crystals of iodide of stannethyl may be distinguished. The oily matter which forms the greater part of the product analysis shows to be the iodide of sesquistannethyl.

A mixture of 80 parts of tin and 20 parts of sodium (a very beautiful white alloy, formed of a mass of fibrous crystals) is immediately acted on by iodide of ethyl, the greater part of the iodide being expelled, and a dry powder being left in the retort. This powder, with a small quantity of hydriodic ether, is introduced into stout glass tubes, which are sealed, and heated to 120° for 12 hours. On breaking the tubes sometimes but a small quantity of gas escapes, and at other times enough to produce an explosion. The tubes contain a greenish black mass with a powerful odour, which causes a flow of tears and very violent sneezing. The mass is digested with ether for 24 hours, and the liquid is filtered into a glass, which has been previously filled with carbonic acid. In this way a yellowish liquid is obtained, which left by itself in a stoppered bottle, deposits a white flocculent matter that is decomposed by hydrochloric acid, producing a limpid slightly coloured oil with a most penetrating odour.

The etherial solution separated from the preceding is distilled to about an eighth of its original volume. In this state of concentration nothing is deposited; but if half the volume of alcohol be added, and the evaporation continued, a limpid oil is soon seen to separate, which swims on a colourless slightly viscous liquid.

The yellow oil is but slightly soluble in ordinary alcohol. Submitted to rectification it begins to boil about 170° to 175°, and the boiling point gradually rises. Towards the end of the distillation the liquid becomes very cloudy, thick white fumes escape, and metallic tin separates in the form of a melted globule. The same yellow oil exhausted by weak alcohol, and then kept for some time in an oil bath, heated to 170° or 180°, until nothing more distils, has a constant composition. If particles of iodine be thrown on it, the liquid becomes hot, but no gas is disengaged; at the same time the irritating odour of the iodide of sesquistannethyl is manifested.

When the rude product of the preceding rectification is digested with chloride of calcium, and distilled again, a small quantity passes over about 180°; then the thermometer rapidly mounts to about 240°, and remains there for some time; the temperature afterwards rises slowly to 280°, and the last drops of the liquid distil between 280° and 290°. In this second rectification a small quantity of tin separates. The two portions of liquid condensed, are colourless, and perfectly limpid.

The viscous liquid is concentrated over a water bath to about half its volume, and then about twice its volume of water is added, by which means there is separated a very slightly coloured semi-fluid oil, greatly resembling a fat oil in appearance. Heated for some hours in a water bath, and then left in a dry vacuum, this oil is quite transparent. It smells like mould. Heat completely decomposes it. Some tin is separated and a colourless very mobile oil is condensed, which is purified by a new rectification. This oil, which has an etherial odour, very different from that of the other compounds of ethyl and tin, is the *distannethyl* recently discovered by MM. Frankland and Buckton. The thick oil which yielded it is stannethyl.

Distannethyl does not unite directly with oxygen, chlorine, or iodine: it never behaves as a radical: it is an inactive substance, which can exchange a portion of its ethyl for chlorine or iodine, to reproduce compounds of the same type; but can assimilate nothing to form compounds of a higher order. This fact demonstrates the persistence of the grouping SnX_2, which we cannot go beyond.

The yellow oil, but slightly soluble in ordinary alcohol, furnished on analysis results which, converted into percentages, were as follows:

	I.	II.	III.			Theory.
C	34·72	35·34	34·88	12C . .	72	35·12
H	7·20	7·45	7·36	15H . .	15	7·31
				2Sn . .	108	57·57
					205	100·00

This product must then be considered as a sesquiethylide of tin, and consequently its formula will be written $Sn_2(C_4H_5)_3$. It unites directly in the cold with oxygen, chlorine, bromine, and iodine, reproducing the oxide, chloride, and iodide of sesquistannethyl.

TECHNICAL CHEMISTRY.

On the Use of Sewerage.[1]

The transport of the sewage matter to a distance from the metropolis has become with the present arrangements a matter of paramount necessity; but the accomplishment of that end ought by no means to stifle the inquiry as to whether some means might not be devised for rendering the same material available for useful purposes.

If the citizens of London were as fully impressed as they ought to be with the importance of this subject, if they could realise the enormous pecuniary loss they are at present sustaining by the system pursued, they would not quietly acquiesce in the report of those chemists who have expressed doubts as to the practicability of employing their sewerage for agricultural purposes, but would persevere in putting both science and capital into requisition until the difficulties had been at length surmounted.

Nor would it be consistent with ordinary prudence to depend upon a foreign, precarious, and probably exhaustible source, for the supply of that material which nature has placed within the reach of every individual in the excreta which he himself furnishes. On the other hand, the other class of reasoners who rely upon the subsoil for restoring at any time and to any extent the loss occasioned by the transfer of the constituents of our crops to our great cities, lean more upon theory than it would be safe to do in matters of such momentous importance.

It may be demonstrable indeed that the crust of the globe, take it all in all, contains an inexhaustible supply of the phosphates, and it may be also true that certain land has been made by diligent tillage alone to yield up to the crop a sufficiency of this ingredient for a period of time, which although nothing compared to the duration of the community in which the trial was made, seems to our limited views as something considerable. But experiments are yet wanting to show what amount of labour, what description of treatment, what period of time, what concurrence of atmospheric conditions, would

[1] From a Lecture on Sewerage, with particular reference to Baron Liebig's remarks relative to the system of disposing of it adopted in the principal cities of this country; delivered on February 3, 1860, in Oxford, by Charles Daubeny, M.D. F.R.S. Professor of Rural Economy in that University.

be required under ordinary circumstances to effect the desired end; and indeed the investigations made elsewhere might lead us to infer that the means employed at Lois-Weedon, even if they could be adopted on a sufficiently large scale elsewhere, would in the majority of cases be insufficient to enable us to dispense with manure. Although the supply theoretically speaking may be inexhaustible, it is certain that the labour and difficulty of obtaining it must increase in a very rapid ratio with its distance from the surface, so that whatever lies below the reach of the subsoil plough may be regarded for practical purposes unavailable.

No doubt the mineral constituents which render a virgin soil so productive were derived from the decomposition of the subsoil underneath, but we know not how many centuries may have been required to bring about this result, and might therefore as well calculate upon making good the consumption of our coal fields, the accumulation of countless ages of vigorous vegetation, by the decay of the timber or herbage now growing upon the surface, as to reckon upon bringing back an exhausted soil to the fertile condition in which it had been handed over to us by nature, through the medium of any transient application to it of mere human industry.

The experiments hitherto made upon subsoiling scarcely warrant our anticipating any sudden restitution of its pristine fertility to the soil, by bringing up portions of the subjacent rock to the surface, for where that has been done incautiously, or on too large a scale, the very opposite result is said to have ensued.

And this is explained by the condition in which the phosphates, as well as the alkaline ingredients, exist in the rock, before they have been made accessible to the influences of atmospheric agents.

In a memoir on the Rotation of Crops, read before the Royal Society, which was honoured by being made the subject of their Bakerian Lecture for 1845, I communicated the results of 10 years successive experiments upon various crops planted under my own direction within the precincts of the Botanic Garden, which led me to at least one important conclusion, namely, that a soil may continue to retain a large amount of all the necessary constituents of a plant, and yet be unable to impart them to it in sufficient quantities, owing to the condition in which they were retained in combination.

Thus after 10 years' cropping, at which time the soil for many sorts of plants appeared to have approached exhaustion, I found by analysis that 6 lbs. of phosphate of lime, equal to about 3 of phosphoric acid, existed in every 100 square feet of soil taken to the depth of 3 feet from the surface, a quantity which would have sufficed for at least 13 more crops of barley, as abundant on the average as those which had been already obtained from the same plot.

And in like manner I found that there was magnesia enough for 34 crops, and of potass for 15.

But the greater part of these ingredients, although they were separable from the rest of the soil by digestion in muriatic acid, was not acted upon by water containing carbonic acid, the latter only extracting $\frac{1}{10}$ths of a grain of earthy phosphate from 5 lbs. of the soil, an amount equal to $\frac{1}{11000}$th part; so that whilst the real quantity as determined by muriatic acid was $\frac{1}{1100}$th part of the soil, that separated by water and carbonic acid amounted to $\frac{1}{10}$th the part of the latter quantity.

These and similar investigations led me to what I consider the most valuable conclusion suggested in the memoir, namely, that the constituents of the soil may be divided into those latent or dormant, and those active or available, it being reasonable to conclude that a substance which cannot be extracted by water containing carbonic acid, the method which Nature adopts, but only by muriatic acid, ought to be regarded as immediately applicable to the uses of the plant.

Before therefore we can predict with any certainty what amount of time it will take to bring an exhausted soil into a fertile condition we must know not only what amount of phosphoric acid and of alkalies it contains, but also what means will avail for converting its dormant constituents into active ones.

On this point I conceive experiments are much wanted; but as they require, like many others relating to agriculture, a considerable lapse of time to complete, as well as a large expenditure of labour, they lie beyond the reach of a person arrived at my time of life, and unprovided with a suitable staff of assistants for carrying on the necessary investigations.

Whatever might be the conclusions to which such experiments conducted, they could not fail to be of the highest practical importance to the public. Should it, for instance, turn out that in the case of ordinary rocks the time and labour requisite for bringing into an available form the constituents of our ordinary crops is so great, that, although theoretically possible, it would in a practical sense be hopeless, in the event of the supply of guano and mineral phosphates falling off, to attempt restoring fertility to a thoroughly exhausted field by such methods as we could put into operation, then, indeed, the future of British agriculture presents a gloomy prospect, unless an entire change in the system of disposing of our town sewerage be speedily resolved upon.

Nothing less than a return to the old method of cesspools, still in use in most continental cities, will [in that case] suffice, to prevent those parts of the country which feed our vast metropolis from sinking gradually into a condition of irremediable sterility.

A country like Great Britain, teeming with population, and already occupying every nook and corner of the land, which Nature has not consigned to barrenness by unfavourable conditions of temperature, elevation, or physical structure, cannot revert to the same expedient which was adopted by our brethren in the New World, who, when they had exhausted the resources of one plot of ground, moved on immediately to the next.

But to take a more hopeful view of the case. Supposing it to be proved that in most instances a calculable amount of labour and capital expended upon an exhausted soil will in the course of time elicit the latent treasures of the subjacent subsoil, and bring it into that condition which it has been, and may be, maintained, so long as guano and superphosphates continue to be supplied.

Still we must recollect that the difficulty of restoring to the land its pristine fertility will go on in an increasing ratio on each succeeding occasion; 1st, because we shall have every time to bring the materials from a greater depth than heretofore, and therefore with a greater amount of labour; and 2ndly, because the constituents brought into an available or active condition will, on each repetition of the process, be diffused over a larger amount of inert matter.

It must be borne in mind, that the fertility of a soil depends, not upon the absolute quantity of phosphates, soluble silicates, and the like, present in each acre of ground, but upon the proportion in quantity they bear to the material through which they are diffused.

Supposing therefore, a soil 3 feet deep to be thoroughly exhausted of its fertilising materials, we cannot expect to restore it to its pristine state by converting another 3 feet of the subsoil into the same condition, into which it had been brought in the first instance by natural agencies, because the phosphates, &c. present in the latter will have to be diffused over twice the quantity of earth as before.

And after all should we not, even at the best, be acting like the proprietor, who, because he had reasonable hopes that his estate contained within itself a vein of precious metal which required only capital and labour to bring to the surface, were to throw into the sea as superfluous his bags of gold, already coined into money, and made available for all the purposes of life; or like the possessor of a colliery of unknown extent, who squandered away in the metropolis the wealth he had derived from his mine, without laying up any provision for the day at which the source of all his revenue might be worked out.

It is enough for us to know that from the disposal of the sewerage of London alone we are incurring a national loss of more than a million sterling; that the principal source from which the lands of this country are maintained in their present state of productiveness is likely in a few years to be dried up; that we are at present in great measure in the dark as to the means by which this loss could be supplied; and therefore that it is of vital importance for the nation at large to use every effort in its power to find some useful application for its excrementitous matters, as well as to determine what other means could be resorted to, for providing against the day when agriculture may have to fall back upon its own unassisted resources through the failure of all supplies from without.

At any rate it must be admitted that whatever improvements have been effected or are in contemplation with regard to the disposal of our sewerage, bear reference rather to the sanitary than to the economical phase of the question; for it will be seen from the statements given in the preceding part of my lecture, that except in a few isolated cases, such as Rugby, the only portion of the excrementitious matters which it is attempted to preserve is the solid, which stands far the lowest in the scale of agricultural value. No doubt it is essential to the health of our cities that the latter should either be deodorised or removed to a distance from the population; and it may be important that neither the one nor the other of these proceedings should be neglected. Still, we can never expect to recover any considerable portion of the value of our sewerage, so long as the liquid portion is suffered to run to waste.

Nor is it as yet clearly made out, how, consistently with the present arrangements, so universal in our large cities, we can procure the latter in a form sufficiently concentrated for general agricultural purposes. All we can hope to do at present is to apply it as a means of irrigation, thus obtaining from the luxuriant meadows which its application to the herbage would create, the fittest material for the maintenance of those herds of sheep and cattle, which are consumed by the population of our great cities, and therefore the best compensation for the loss sustained by the provinces which supply them with food.

If, therefore, there be any truth in the views which Baron Liebig has propounded, and of which I have undertaken in this lecture to become the humble expositor, the time is drawing on when the people of this country, if no improvements in our modes of concentrating our sewerage be discovered, will have to revert to the practices of communities whom, in the pride of their self-conceit, they consider less advanced in civilisation than themselves, and even to admit that after all our boasted progress in the arts, the oldest and least improvable nation on the face of the globe presents the nearest approach to a correct system in the disposal of its excrementitious matters; or else they must find, within a certain area of the metropolis, a sufficient tract of meadow land to receive the diluted contents of the sewers, and to absorb all the valuable materials which they carry with them.

I am fully aware of the difficulties which attend either scheme, but I cannot but think that if the nation were alive to the importance of the subject, and were conscious that in a few years the necessity of grappling with it must force itself upon its consideration, it would not be content in the mean time to derive its information on a matter of such importance from individuals only, and those often foreigners, but would regard the question at issue as one not less deserving the attention of government than any of those other subjects which come within the cognisance of parliamentary committees.

PHARMACY, TOXICOLOGY, &c.

On Quinio or Rough Quinine, by M. Batka.[1]

A substance is known in the Brasils under the name of quinio, which is extracted from the fresh bark of the cinchona by lime and then from the lime by alcohol. It is very rich in quinine, and it is only necessary to boil it with dilute sulphuric acid to obtain an abundant crystallisation of pure sulphate of quinine.

Quinio is a yellow body of a resinous appearance and of a bitter taste. It is insoluble in cold and but slightly soluble in boiling water. It is very soluble in alcohol and ether separating partially from the latter by exposure to the sun. Water precipitates the alcoholic solution. It is almost entirely soluble in weak sulphuric acid, from which soda precipitates it of a dirty white colour, the precipitate assuming the appearance of a resin. A beautiful white sulphate however may be prepared from it.

Quinio is free from cellulose; when heated it gives off an odour something like cinnamine, and burnt leaves a light residue of carbonate of lime. It resembles a good deal the quinoidine of Liebig, but is much purer than the quinoidine of commerce.

Substitutes for Quinine.[2]

The Society of Pharmacy of Paris proposed as the subject of a prize, the artificial formation of quinine or the discovery of a substitute possessing equivalent febrifuge properties. Nine essays were sent in, and at the sitting on November 2, 1859, M. Buignet gave an account of the results of their examination. The nine essays related to as many different substitutes.

1. A common indigenous plant of which the author described the properties, but did not give the name nor even any description of its botanical or chemical characters.

[1] *Chem. Centralblatt*, 58, s. 913.
[2] *Journal de Pharm. et de Chimie*, Fév. 1860.

2. On the resin of *plantain* such as can be obtained from the plantago major, minor and lanceolata by means of alcohol and proper treatment.

3. On the bark of the *cail-cedra*, khaya senegalensis.

4. On a substance obtained from leukol by particular treatment, the description of which was so vague that the commission could not repeat it.

5. On the tannate of peroxide of iron, which is nothing more than writing ink.

6. On the tincture of an unknown plant.

7. On various substances simply enumerated without any pharmaceutical or medical account.

8. On a particular preparation which the author regards as modified cinchonine, and which appeared to him a febrifuge equal to quinine.

9. On the ferrocyanide of sodium and salicine.

But a few of the authors had fulfilled the condition which required them to send a specimen of at least 250 grammes of the new febrifuge. Those which had been sent had been tried in the military hospitals at Rome, Ajaccio and Perpignan, but the reports from medical officers of the army had not supported the results announced by the authors. The Council decided not to grant the prize at present, but to leave it open until the 1st of July 1861. The great progress made in organic chemistry, and the constantly increasing number of alkaloids made artificially, leaves no doubt that the study will lead to the desired solution.

The prize of the society is 6000 francs, to which the Minister of War will add 4000 francs.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, 17 February, 1860.

JOHN WEBSTER, *M.D. F.R.S. in the Chair.*

On the Influence of Science on the Art of Calico-Printing, by PROFESSOR F. CRACE CALVERT, *F.R.S. F.C.S. &c. &c.*

CALICO printing has partaken of the general progress of the manufacturing arts; and this can be easily understood when it is remembered that it is based upon three distinct branches of knowledge — mechanics, art, and chemistry. Not being acquainted with machinery, I shall not attempt to describe the various mechanical improvements and machines which have been introduced; but shall confine myself to stating that ever since 1815, the period at which it was first extensively employed in the printworks of Lancashire, machinery has gradually supplanted hand labour, and thereby immensely decreased the cost of production, at the same time that it has improved the beauty and precision of the results obtained.

Pencilling and Block-Printing. — During the early part of this century, the production of designs upon calico was performed by means of hand blocks, made of sycamore or peartree wood, two or three inches thick, nine or ten inches long, and about nine broad. The face of the block was either carved in relief into the desired pattern, like ordinary woodcuts; or the figure was formed by the insertion edgewise into the wood of narrow slips of flattened copper wire, and the patterns were finished by the hand labour of women with small brushes called pencillings. Owing to a strike amongst the block-printers in 1815, to resist the threatened introduction of machinery, great efforts were made on the part of the employers to render themselves independent of hand labour; and the result has been the gradual introduction of cylinder printing. Without entering into the intricate details of the steps by which the art of engraving has been carried to its present high degree of perfection, I shall simply give an outline of the successive improvements alluded to.

Engraving. — The first kind of roller used was made by bending a sheet of copper into a cylinder, soldering the joint with silver, and then engraving upon the continuous surface thus obtained.

The second improvement consisted in producing the pattern on copper cylinders obtained by casting, boring, drawing, and hammering. In this case, the pattern is first engraved in intaglio upon a roller of softened steel, of the necessary dimensions. This roller is then hardened and introduced into a press of peculiar construction, where, by rotatory pressure, it transfers its design to a similar roller in the soft state, and the *die* being in intaglio, the latter, called the "*mill*," is in relief. This is hardened in its turn, and by proper machinery is made to convey its pattern to the full-sized copper roller. This improvement alone reduced the cost of the engraving on copper rollers many hundreds per cent.; and, which is of far greater importance, made practicable an infinite number of intricate engravings which could never have been produced by hand labour applied directly to the roller.

A further improvement was made by tracing with a diamond on the copper roller, covered with varnish, the most complicated patterns by means of excentrics, and then etching.

The combination of mill engraving with the tracing and etching processes naturally followed, adding immensely to the resources of the engraver and printer in production of novel designs.

Another development of this art is the tracing of patterns on the surface of rollers, which has been effected by machines constructed on the principle of the pentagraph. Although this invention dates from 1834, still it is only of late years that it has been successfully applied.

But if mechanical art has greatly assisted the engraver, chemistry has rendered him equally important services, by enabling him to abandon costly and cumbrous modes of impressing by force the designs on the cylinder, substituting for them a great number of etching processes. By some of these processes, as by every other addition to the resources of the engraver, an entirely new and beautiful class of engraving is produced, unattainable by any other known means.

A very recent improvement is highly interesting in a scientific point of view. It is the application of galvanism to the diamond tracer. By combining the galvanic action with the excentric motion, most beautiful and delicate engravings can be produced. This is effected by tracing the pattern with a varnish on a zinc cylinder, which is so placed in the engraving machine, that as a needle passes over its surface, and comes in contact with the zinc, the galvanic current is established, and by simple machinery, causes the diamond to trace the corresponding pattern on the copper roller. The communication is so rapid and so precise, that this invention of Mr. Gaiffe, of Paris, bids fair to produce very important results. Galvanism is also made use of, for producing effects on roller surfaces by depositing copper thereon.

To give an idea of the extraordinary influence which the introduction of machinery and improvements in engraving have had in cheapening the cost of printed calicoes, I may state that large furniture patterns, such as are required for Turkish, Egyptian, and Persian markets, into which sixteen colours and shades enter, would have cost formerly from 30*s.* to 35*s.* per piece, because they would have required 16 distinct applications of as many different blocks, and would have occupied more than a week in printing, whereas the same piece can now be printed in one single operation, which takes three minutes, and costs 5*s.* or 6*s.* So rapid is the progress of one branch of manufacture in connection with another, that it has only recently been possible to produce the rollers capable of performing this operation, that is to say, cylinders of copper 43 inches in circumference by 44 inches long. For light styles of printing, the time reqiured to print a piece of 36 yards is not more than one minute.

Chemistry. — But the discovery which has exercised more influence than any other on the progress of calico printing, is the application of *chlorine* gas as a bleaching agent. Previously to the employment of this gas (chiefly as bleaching powder), the imperfect bleaching of a piece of calico required six weeks; and as it had to be exposed to the action of the atmosphere, a large surface of land was required. Further, at that time bleachers had to use potashes imported from Canada; whereas at the present time, thanks to the progress of chemical knowledge, not only is soda-ash manufactured in this country, but by the application of bleaching powder calicoes are much better bleached in 24 hours than they were formerly by a six weeks' exposure to the atmosphere; and even when an extra cleaning and whiteness is required, as for madder goods, only two days are necessary. The aid of machinery renders possible the continuous process; that is to say several hundred pieces of grey calico are sewn together, end to end, and made to pass from one operation to another without any pause, until they are bleached. So rapid and economical is this method, that the cost of bleaching a piece of calico does not exceed one or two pence. Chlorine again renders a great service to the calico printer, by enabling him, after his *madder goods* have been produced and soaped, to obtain fine whites without the necessity of exposing them for several days in the meadows to the action of the atmosphere. In fact the discovery of *garancine* and *alizarine*, and their application to calico printing, have facilitated the production of madder styles at very low cost, as the whites of such goods require no soaping, and only a little bleaching or cleaning powder.

Cotton has this peculiarity as distinguished from wool and silk, that it will not fix any organic colour excepting indigo, without the interposition of a mordant, which is generally a metallic oxide or salt. The two most important discoveries in connexion with this necessity of calico printing were, first that made in 1820, by Mr. George Wood, of Bankbridge, who found out the means of preparing calicoes with peroxide of tin, which enabled printers to produce a large variety of prints called *steam goods*; and secondly that of Walter Crum, Esq., F.R.S., who, in a paper presented to the British Association at Aberdeen, in 1859, showed that the tedious process of ageing madder mordants for three or four days might be dispensed with by passing the goods during a quarter of an hour through a moist atmosphere, at a temperature of 80° to 100°, where the mordants absorb the required quantity of moisture, and then rapidly undergo the chemical changes necessary to fit them for producing the black, purple, lilac, red, pink, and chocolate colours, which the madder root will yield immediately in the dyebeck, according to the nature of the mordant previously fixed in the cloth.

As it is impossible in the brief space of an hour to convey an idea how various colours are produced on prints, I shall confine my remarks to illustrating the interesting fact that abstruse science has brought to light various substances which have lately proved valuable accessories to the resources of the calico printer. Thus Dr. Prout, some thirty or forty years ago, made the curious discovery that uric acid possessed the property of giving a beautiful red colour when heated with nitric acid and then brought into contact with ammonia. The substance thus obtained was further examined by Messrs. Liebig and Wöhler, in a series of researches which have been considered as amongst the most important ever made in organic chemistry; and this substance they called *murexide*. In the course of these investigations they also discovered a white crystalline substance called alloxan. For twenty years both these substances were only to be found in the laboratory; but in 1851 Dr. Sasc observed that alloxan when in contact with the hand tinged it red. This led him to infer that alloxan might be employed to dye woollens red, and further experiments convinced him that if woollen cloths were prepared with peroxide of tin, passed through a solution of alloxan, and then submitted to a gentle heat, a most beautiful and delicate pink colour resulted. Subsequently murexide was employed and applied successfully by Mr. Depouilly, of Paris, to dyeing wool and silk, and to printing calicoes, by the aid of oxide of lead and chloride of mercury as mordants; but the great obstacle to its extensive use was the difficulty of obtaining uric acid in sufficient quantity for its manufacture. The idea soon occurred to chemists to extract it from guano, and this is the curious source whence the chief supply of uric acid is obtained, and which enables Edmund Potter, Esq. and other printers to produce the colour called Tyrian purple.

Another example will be found in the successive scientific discoveries which have led to the discovery of the recently popular colour, *Mauve*. Lichens, which have been the subject of extensive researches on the part of Robiquet, Heeren, Sir Robert Kane, Dr. Schunck, and especially of Dr. Stenhouse, have yielded to those chemists several new and colourless organic substances, which, under the influence of air and ammonia, give rise to most brilliant colours, and amongst these are orchil and litmus. Dr. Stenhouse, in a most elaborate paper, published by the Royal Society in 1848, pointed out two important facts; first, that the colour-giving acids could be easily extracted from the weed by macerating it in lime water, from which the colouring matters were easily separated by means of an acid; and, secondly, the properties of certain colouring acids, which gave M. Marnas, of Lyons, the key which enabled him to produce commercially from lichens a fast mauve and purple which up to 1857 had been considered impossible of attainment.

The commercial production, by Mr. W. H. Perkin, of another purple, at the same time, is not less interesting. Some thirty or forty years ago, Dr. Runge obtained from coal-tar six substances; amongst which was one called *Kyanol*, which substance was thoroughly examined by Dr. A. W. Hofmann, who proved it to be an organic alkaloid, and identical with a substance known by the name of aniline. Owing to the subsequent study of this substance by that eminent chemist, and the discovery that it yielded a beautiful purple colour when placed in contact with bleaching powder, his pupil, Mr. W. H. Perkin, was induced to make experiments, with a view to producing commercially a fast purple, in which he succeeded, and secured it by a patent in 1857. The process devised by this chemist is exceedingly simple. It consists in oxidising aniline by means of bichromate of potash and sulphuric acid. I shall not attempt to give any further details on this subject, as they have been very ably described by Mr. Robert Hunt in the *Art Journal*.

More recently Mr. Renard found a method of producing, also from aniline, by means of chlorine compounds, a most splendid rose colour, called by him *Fuchsiacine*; and, within the last few months Mr. David Price has also succeeded in producing from aniline, by the employment of peroxide of lead, either a fast purple, or a pink, called by him Roseine, and a fast blue, according to the mode of operating. All these colours require some special mordants to fix them on calicos or muslins; and the beautiful specimens which I have the honour to lay before you I owe to the kindness of Messrs. James Black and Co., and Messrs. Boyd and Hamel, of Glasgow, who have fixed the last-mentioned colours by means of azotised principles, such as albumen, lactarine, &c.

I cannot give a better idea of the immense magnitude of the calico-printing trade than by quoting the number of yards exported, which amounted in 1858, to 785,666,473— and give a price value of 13,147,280*l*.

I cannot conclude without expressing also my thanks to Mr. Wood, of the firm of Wood and Wright, and Mr. R. Leake, of the firm of Lockett, Sons, and Leake, Messrs Dalglish and Faulkners, for the numerous and valuable specimens which they have kindly sent me to illustrate my discourse; and especially to Mr. W. Grant for the loan of a most interesting book, containing the patterns belonging to the late firm of Sir Robert Peel, Bart., which bears the date of 1790.

SOCIETY OF ARTS, 22 *Feb.* 1860.

SIR T. PHILLIPS, *F.G.S. (Chairman of Council) in the Chair.*

On this occasion Mr. S. SQUIRE BAXTER undertook to explain to the meeting the general characteristics of a *New Lime Light*, and read a somewhat desultory paper upon the subject, the light itself being exhibited during the greater part of the evening. Our readers are doubtless aware that a "Company" has been formed for the purpose of developing the patented improvements of Mr. G. H. Bastable in this direction, and that the principle of this so-called "New Light" differs but in some trifling mechanical details from the oxy-hydrogen arrangements of nearly forty years ago. The first half of Mr. Baxter's paper was devoted to general remarks upon the moral, social and commercial advantages of increased supplies of light, and to notices of the chief methods adopted for street and domestic illumination up to the present time. At length he said,—

"It was found by Drummond that many substances were capable of producing light in conjunction with gases, but that of all those which were available for the perfect combustion of the gases, chalk lime was the most suitable material for the purpose, and hence the name (of the "Lime Light." It was also the cheapest and most easily attainable in any locality. It was likewise found that several gases, compounds of hydrogen, might be successfully employed in combination with oxygen gas as well as pure hydrogen.

Pure hydrogen gas obtained from zinc and diluted sulphuric acid, offers facilities in cases where caburetted hydrogen, as supplied by the gas works, cannot be readily procured, but coal gas where available, is a most desirable substitute for the ordinary applications of the light.

The product resulting from the generation of pure hydrogen gas from zinc and sulphuric acid is sulphate of zinc, which from the extensive demand for it as a material used in the manufacture of paint, &c. will always find a ready sale at a price which will leave the cost of the gas in favourable contrast with other gases which may be used for the purpose."

Other sources of hydrogen were then noticed, and the lecturer proceeded to describe the second ingredient of the light— oxygen,—naming the various substances from which that gas may be obtained, but giving the preference to the peroxide of manganese. As some rather extraordinary statements are made in this place we give the original:—"The peroxide of manganese requires simply to be placed in a retort, and raised to a red heat, when the oxygen gas is freely disengaged. So soon as the gas ceases to be evolved from the manganese (which can only be effected practically to the extent of about 11 per cent., although it contains at times 80 per cent.), the residuum, the deutoxide or sesquioxide (!) of manganese may be drawn from the retort, and if thrown into water, or exposed at a high temperature to the action of the atmosphere, it will attract oxygen with great avidity, and thus this refuse becomes revivified or resumes its former state of a peroxide, fitting it by this operation for a repetition of the distillatory process. This peculiar property of the deutoxide of manganese (of rapidly absorbing oxygen from the surrounding air, or other oxygenated bodies brought into contact with it) gives to this substance a great commercial value as a material for producing oxygen gas; for since the actual consumption of the manganese is thus limited by the quantity necessary to provide for the supply of gas during the time required for the revivification of the exhausted material, a comparatively small stock only will be needed to compensate for the unavoidable waste consequent on this mode of operating upon it. In addition to this source of economy, the demand for the deutoxide of manganese for chemical purposes in glass-making, bleaching, and other processes in the arts, presents a means by which the residnum may be disposed of at a price which will leave the cost of the gas merely nominal."

Upon such observations as the preceding, comment is by no means a pleasant task, so, as all readers will at once notice the palpable errors and confusion of chemical nomenclature contained therein, to say nothing of dictional backslidings, we will refrain from playing the critic too severely by passing on to the mechanical arrangements, where our author is a little more at home. The *improvements* upon which the "Lime Light Company" have staked their existence Mr. Baxter thus describes:

"To effect the desired object of protecting the lime from crumbling away, and of ensuring a practically unlimited supply, the simple expedient of enclosing the lime in a case or guard, both above and below the point of ignition, was resorted to, exposing only such portion of its surface as was required for the action of the gases; and by giving to the lime so enclosed a movement within the tube, the retention of the broken portions of lime was insured, until by simple means they were allowed to escape without detriment to the light, or were replaced by a fresh supply in as simple a manner as the cotton wick of an Argand lamp, thus effecting with the perfect continuity of the light for any reasonable period (a fortnight or more if necessary) of time, the maximum brilliancy of light.

So simple are the mechanical appliances for producing these results, that they fall as much within the compass of the ordinary attention bestowed on such objects as an ordinary lamp.

Thus, it results that lime, for any reasonable period, may be supplied to the lamp, producing a continuous and steady light so long as the gases and lime are supplied to it.

The two gases are kept under equal and uniform pressure in gas holders, which are connected with the lamp by pipes. The gases are kept separate until they have passed the regulating taps, and then they are mixed, and pass together, through wire gauze protectors (to prevent the regurgitation of the flame), into the jet tube, from the orifice of which they are projected together on to the surface of the lime, producing an intense light.

The carburetted hydrogen gas, where it cannot be obtained from a contiguous gas main, may be procured from oil or Leslie's gas liquid at a cheap rate, the process of generating it being one of extreme simplicity, as it does not involve the necessity for the extensive appliances of a gas works, which, though to a great extent unobjectionable for manufacturers of gas, are nevertheless unsuited for private purposes."

Some remarks upon the peculiar capabilities of the "lime light" and the various advantages to be derived from its use, here succeed, and the paper concludes with the question of expense:

"The cost of the light may be stated, in general terms, to be one half the price of its equivalent gas light, all expenses being taken into consideration.

It has already during the last eighteen months been used at various places, and is now being permanently exhibited on the south landing stage at Liverpool, and the members of the society will, in the course of a few days, have an opportunity of witnessing its capability on the first half of the new Westminster Bridge.

The following is a tabular statement of the comparative value of light from various substances, compiled from data derived from a series of experiments made by Mr. E. V. Gardner, at the Royal Polytechnic Institution, Regent Street."

Description of Material.	Particulars of Burners, &c.	Value in Wax Candles, 6 to the pound.	Consumption of Material per hour.	Units of Cost.	Cost per hour of Light of equal intensity.
Lime light, with coal gas	Jet $\frac{1}{10}$ in. diam.	758	ft. 7·2 ox. 7·8 gas.	9	d. 1·00
Lime light, with hydrogen	" "	1167	6·53 ox. 12·4 hy.	10	1·11
Argand gas light	" 15 holes	20·18	0·50 cub. ft.	17	1·88
Fish-tail "	" No. 1	0·7	2·41 "	18	2·00
Ditto "	" No. 4	6·66	5·00 "	40	4·44
Moderator oil "	" 1 in. diam.	19·5	860 grains.	42	4·66
Argand "	" $\frac{15}{16}$ in. diam.	14·15	697 "	97	10·22
Bude "	" "	151·25	4000 "	117	13·00
Wax candle "	6 to the pound.	1	130·5 "	599	66·55

This table of experimental values must, we suspect, be viewed with considerable caution, particularly if based upon the "peculiar property" of the "deutoxide or sesquioxide of manganese" before alluded to.

Dr. Letheby opened the discussion by totally disagreeing with the author of the paper on the subject of cost. According to his (Dr. L.'s) calculation, the oxygen if derived from the chlorate of potassium would cost 9*l.* 12*s.* per 1000 cub. feet, while ordinary coal-gas was now produced at the rate of 1*s.* 6*d.* for the same quantity, and he considered that upon this estimate the *lime light* would be far more expensive than gas for an equal amount of light. Even upon the patentee's estimate of 3*l.* 15*s.* for the above quantity of oxygen, Dr. Letheby thought that the new light would cost fully twice as much as coal-gas. Besides this the light was too intense to be pleasant, which was calculated to bring on paralysis of the retina. The revivification of the oxide of manganese was distinctly an impossibility, and the speaker finally characterised the light as the most expensive that could be adopted, and one of the most dangerous to the eyesight of those using it.

Dr. Bachhoffner said that he had probably had more experience with this light than any other man, having used it daily for more than twenty years; he believed that for ordinary purposes of illumination the lime light would fail completely, at the same time he could not quite agree with the views of Dr. Letheby, who had overrated its cost. The light exhibited he did not consider satisfactory, nor was it at all suited for the oxyhydrogen microscope — the pressure was far too low. According to Dr. Bachhoffner, with a water-pressure of 13 inches, he obtained a light equal to 25·9 Argand burners, each containing 6 feet of gas per hour, the cost of the lime-light (with oxygen and coal-gas) being 1*s.* 10½*d.* per hour, while the same amount of light from ordinary gas burners for a similar period would cost 8½*d.* only. He condemned the use of chlorate of potassium as both expensive and injurious to brass work — denied that exhausted peroxide of manganese could be restored, or possessed any marketable value, and said he had seen hundreds of tons of sulphate of zinc thrown away, as nobody would be at the trouble of fetching it.

Various observations were made by different speakers which want of space forbids us to transcribe, but we may briefly note that Mr. Lambert said he formerly knew a German chemist, Mr. G. Michiels, who obtained oxygen from the atmosphere by passing heated air over hydrate of baryta until the latter had absorbed its maximum of oxygen, when at a higher temperature the gas was again evolved, and could thus be collected. Mr. Michiels told him that oxygen could be obtained by this method, at about the same cost as coal-gas, but he was unfortunately killed by a laboratory accident before his plans were fully developed.

The meeting terminated with the usual vote of thanks.

CORRESPONDENCE.

Nutritive Properties of Aluminised Bread Food.

To the Editor of the Chemical News.

Sir,—At a discussion on the "Chemical Properties of Milk," reported in your impression of the 18th Feb. Dr. Routh states,—

"That the effect of alum, which nearly all bread contains, is to fix phosphoric acid in a perfectly insoluble form, and thus to deprive the infant of an ingredient essential for its nourishment.

"That aluminised bread food was as sure a poison as opium or any other poison, if long persisted in.

"That the absence of chloride of potassium (a salt absolutely required for the progress of the cell growth) in vegetable food, is an objection to its use."

It surely cannot be allowed that statements so calculated to mislead should go forth to the public unchallenged, more especially when made by so eminent an authority as Dr. Routh.

The effect of alum is not to form under these circumstances an insoluble compound with phosphoric acid; for although such compound is insoluble in water *per se*, yet it is perfectly soluble in the presence of a large amount of organic matter.

If an insoluble compound were formed it would not have the effect of withholding the supply of phosphoric acid, inasmuch as only a very small proportion of the phosphoric acid contained in the bread would be sufficient to combine with all the alumina, even if the bread were adulterated to a much greater extent than is ever found to be the case; for whilst the alumina would not exceed 1·4 grs. in the pound, the quantity of phosphates would be about 70 grs.

The adulteration of flour with alum is by no means so common as is generally supposed. In those cases in which it is used, from 1 to 2 oz. is mixed with 56 lbs. of flour. Take however the larger quantity, say 2 oz. Bread made from such flour would not contain more than about 14 grains of alumina in the pound, and assuming that alum possesses all the injurious properties which have been attributed to it, surely it cannot be classed with "opium or any other poison."

I am not aware upon what grounds Dr. Routh makes the assertion respecting the necessity of chloride of potassium for cell growth, but such a conclusion can scarcely be drawn from the fact of the cell formation containing this salt. It is well known that in the vegetable kingdom chloride of sodium can take the place of chloride of potassium, and there appears to be every reason to believe that it is perfectly immaterial whether the potash supplied in food exists as chloride, or as phosphate, or sulphate (of which latter salts all vegetables contain abundance), more especially where these are associated with chloride of sodium.—I am, &c.

Common Sense.

The Atomic Theory.

To the Editor of the Chemical News.

Sir,—I should be very sorry if Mr. Reynolds were to think the atomic theory a favorite of mine; on the contrary I only hold it until I am acquainted with a better one to which I can flee. I shall be very much obliged to Mr. Reynolds, or any one else who enlarges on this subject, feeling confident that the path to truth is much cleared by our not being ashamed of our opinions. To the point. The atomic theory (divested of those relations to chemical compounds which were added by Dalton) merely supposes matter to be a congregation of indivisible atoms. From this simple hypothesis there can be deduced these three corollaries:

Cor. I. Atoms are perfectly hard (since anything but perfect hardness is incompatible with indivisibility).

Cor. II. Atoms are perfectly inelastic (since elasticity depends on the amount of motion among smaller particles).

Cor. III. Atoms are impenetrable (since penetrability is intimately connected with softness).

Thus armed, I will attempt to reply to the letters written by Mr. Reynolds. The first argument in Gimel's letter evidently points to the *mathematical* division of an atom, with which we have nothing to do—the atomic theory being a branch of physics and not of mathematics. In the second argument he wishes to know how the parts of atoms are held together; in reply, I direct his attention to corollaries I. and III. As to the last part of his letter I entirely agree with him, not seeing myself the necessity of adopting Dalton's addition. In the first part of his other letter (*i. e.* the one signed A. Reynolds), I think that perhaps there he may be in the right, because, as Richard Laming observes, "the forces of gravitation and cohesion spring from different

sources." However, in the second part of the argument, when he says, "It (*i. e.* an atom) cannot be hard or soft," I refer him again to corollary I. Finally, I have to agree with him that atoms only possess *negative* properties.

I am, &c.

T. S. Barrett.

The Atomic Theory.

To the Editor of the Chemical News.

Sir,—I have not had an opportunity before of replying to the letter of a correspondent in No. 9. of the Chemical News, in which it is endeavoured to be proved that matter is composed of *indivisible atoms*. It appears to me that T. S. Barrett has allowed himself to be misled by his own fallacious argument, and if you will allow me I will point out where I think this fallacy exists. He says that, "if matter were *infinitely* divisible, we should have $r=0$," *i. e.* on the supposition of the *infinite* divisibility of matter, the particles (not atoms) which *compose* matter would be finally lost, in fact, give up their material nature, and become absolute nonentities. Now, it need hardly be said that the objectors to the existence of atoms, do not believe that matter is made up of an infinite number of nothings. And this assumption involves another, *i. e.* that matter is *not* infinitely divisible, for if we suppose that the infinite divisibility of matter results in its destruction, then there is no need to prove that its division cannot be carried further. T. S. B.'s conclusion, without the first assumption becomes worthless; for if, as is undoubtedly the case, r always has some value to whatever extent the division of matter may be carried, the argument drawn from $g \propto r$ merely proves that matter is composed of particles which possess the property of extension.—I am, &c.

J. Noble.

Chemical Nomenclature.

To the Editor of the Chemical News.

Sir,—A correspondent (Your Weekly Guest) asserts that no distinctive title has been applied to the radical NO_6 and others similarly constituted. This I think is incorrect, as in an elementary work on chemistry by Professor Wilson, forming one of the volumes of *Chambers's Educational Course*, it is stated that names have been applied to them; NO_6 is called nitration, SO_4 sulphion, KNO_6 nitrationide of potassium, &c. But I think that any alteration in the existing system would be injudicious, inasmuch as it is supposed to be understood that before a metal can combine with an acid (as NO_6) it must be oxidised; and to be consistent, names must be found for salts containing acids other than those which terminate in *ic*. In addition, there would be the inconvenience of having two systems of nomenclature adopted by those holding opposite views of the nature of acids and salts.—I am, &c.

John Tillman.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Permanganate of Potash.—Luboldt[1] points out that a standard solution prepared with the crystallised permanganate may be kept a year without any change of composition.

Compounds of Bismuth with Chlorine, &c.—According to Weber[2] protochloride of bismuth is easily obtained by heating the trichloride of bismuth, $BiCl_3$, with metallic bismuth. The protochloride forms a brown black crystalline mass very fusible and decomposable by water. A very high temperature changes it into the perchloride and the metal. Concentrated solution of sal-ammoniac also decomposes it. Analysis leads to the formula $BiCl_2$. It may be obtained by the direct action of chlorine on bismuth, but so conducting the process that the current of chlorine shall only arrive at the upper part of the retort containing the metal. Phosphorus, zinc, tin, mercury, silver, &c. partially reduce the perchloride of bismuth with formation of protochloride. Perbromide of bismuth $BiBr_3$ will also form a protobromide when heated with the metal. It forms a brown crystalline mass presenting analogous characters to those of the protochloride. It has not been obtained in a state of purity: there has always been bismuth in excess.

The tri-iodide of bismuth is easily obtained by projecting small portions of iodine on bismuth strongly heated in a tube, and distilling the product out of contact with the air. It is crystalline and of a metallic black colour. It behaves with bismuth like the tribromide.

II. ORGANIC CHEMISTRY.

The pretended Quinic Ether.—M. Galvani shows[3] that the supposed quinic ether (Chemical News, p. 10) is nothing more than a mixture of ether and alcohol contaminated with some empyreumatic matters; and that the peculiar odour which led it to be considered as a special ether, was due to the presence of some neutral sulphate of methylene.

Saccharide.—After sugar has been melted, a part of it is found incapable of crystallisation and fermentation. To this M. Gelis[4] gives the name of *saccharide*. To isolate it he ferments melted sugar, which destroys the glucose, and leaves the new substance in solution. The solution carefully evaporated gives a syrup, which kept for more than a year in a dry place shows no sign of crystallisation. Saccharide turns the plane of polarisation to the right, but it is changed to the left by the action of acids, or by keeping the saccharide a long time in solution.

Quercitrine in the Coloration of Flowers.—Hlasiwetz[5] suggests that quercetrine may play an important part in the coloration of flowers. He states that one milligramme of quercetic acid is sufficient to communicate a beautiful rose colour to 20 pints of slightly alkaline water. Only a trace of a salt of iron is necessary to colour a solution of quercetine green, and an infinitesimal quantity of quercetic acid will colour blue a very dilute solution of perchloride of iron. With these reactions in view, it is easy to explain the play of colours hyacinths, tulips, and dahlias present, supposing these plants contain quercitrine, which as we have seen (Chemical News, p. 107) contains the elements of quercetic acid and phloroglucine. The concurrence of ammonia, air, or sunlight, and the ferruginous compounds in the sap, will be sufficient to produce the following shades:

Quercitrine or quercetine . . .		colours	yellow
Quercitrine in presence of alkalies and oxygen		„	brown
„ „	sesquioxide of iron	„	green
Quercetic acid		„	blue
„ „	alkalies and oxygen	„	red
Phloroglucine „	sesquioxide of iron	„	violet.

When it is attempted to isolate the colouring matter of flowers but a very small quantity is obtained, which is explicable on the supposition that as only a trace of quercitrine is necessary to give an intense coloration to a solution it may be the same with flowers.

M. Nicklès adds a note in the *Journal de Pharmacie et de Chimie* (Feb. 1860) which says that the above reactions give the key to a sort of industry which has for some years made a great noise in the horticultural world. A pharmacien of Milan has obtained azalias, camellias, &c. of a beautiful blue colour, by growing them in a strongly ferruginous soil. Another amateur has succeeded in the same object by watering his plants with very weak solution of sulphate of iron.

Quercitrine, he adds, is not the only organic matter capable

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[1] *Journal für Praktisch. Chem.* Bd. lxxvii. s. 315.
[2] *Poggendorff's Annalen*, Bd. cvii. s. 596.
[3] *Moniteur Scientifique*, 15 Fév. 1860.
[4] *Journ. de Pharm. et de Chimie*, Fév. 1860.
[5] *Allgemeine Zeitung*, Nov. 10, 1859.

of these metamorphoses. Salycilic, gallic, pyrogallic acids, and all the varieties of tannin produce with alkalies and salts of iron shades of colour like those of which Hlasiwetz speaks.

III. CHEMICAL ANALYSIS.

Separation of Magnesia from the Alkalies.—M. Chancel[6] applies his method of estimating phosphoric acid (CHEMICAL NEWS, p. 72) for the separation of magnesia from the alkalies. The magnesia is first precipitated in the presence of chloride of ammonium and free ammonia by pure phosphate of ammonia. The proportion of magnesia is thus obtained at once. The filtered liquid and the washings contain the alkalies, ammoniacal salts and the excess of phosphoric acid. It is evaporated to dryness, and the residue is calcined to expel the ammoniacal salts. It is then redissolved in water, and to the solution is added first nitrate of silver, and then a slight excess of carbonate of the same base. If the alkalies are in the state of chlorides, the precipitate with nitrate of silver need not be noticed, for it does not interfere with the action of the carbonate nor with the separation of the phosphoric acid; it is only important to add so much of the nitrate that after the separation of the chlorine enough may remain in the liquid. When the precipitate of phosphate of silver is collected and the liquid is clear and quite neutral, it is filtered, and the excess of silver is removed by means of hydrochloric acid. The alkalies are then in solution quite free from any other fixed principle, and may be determined without trouble by the usual processes.

Detection and Estimation of Iodine.—M. De Luca[7] detects minute quantities of iodine in rain and other waters, by precipitating them with nitrate of silver. The precipitate is washed and thoroughly dried, and is then introduced into a tube in which is also placed a small bottle of very thin glass filled with bromine vapour. The tube is now filled with carbonic acid gas and sealed. It is then shaken to break the bottle and liberate the bromine vapour, which immediately decomposes any iodide of silver, setting free the violet vapours of iodine. These condense in the cold part of the tube and may be dissolved out by alcohol. The amount of iodine may be estimated by a standard solution of sulphurous acid, and the hydriodic acid may afterwards be reconverted into iodide of silver and weighed. The process gives very exact results; as it is conducted in a sealed vessel no loss is experienced.

Lead in Filtering Paper.—M. Wicke[8] calls the attention of toxicologists to the fact that some filtering papers contain lead. A piece four inches square yielded him a distinct precipitate of sulphide of lead.

IV. TECHNICAL CHEMISTRY.

Soluble Glass.—At the request of the Austrian Society of Civil Engineers, Lielegg has studied soluble glass, both with regard to its chemical properties, and its applications.[9] He first examined three specimens of the soluble glass from three different manufactories, and found their composition as follows:

	I.	II.	III.
Water	65·879	38·66	0·689
Silica	22·258	44·64	63·6
Soda	11·178	16·252	„
Potash	„	„	34·4

I. Was silicate of soda made by Siedel of Liesing,
II. Silicate from a manufactory in Munich,
III. Silicate of potash by Kuhlmann of Lille.

The richer the glass is in silica, the less fusible it is. To attain the maximum of fusibility it must contain both soda and potash.

By pouring a concentrated solution of silicate of soda into alcohol, there is formed by degrees a mucous deposit insoluble in alcohol, which hardens after some days. This deposit is soluble in water. The alcoholic mother liquor contains all the impurities in the soluble glass employed. This process of purification is specially applicable to the soluble glass destined to be used in stereochromy.

By triturating soluble glass with quick lime the silicate rapidly hardens, forming silicate of lime and caustic soda. Exposed to the air, the mass becomes covered with an efflorescence of carbonate of soda.

With oxide of zinc soluble glass forms a viscous liquid containing some silicate of zinc, which has already led to the idea of using soluble glass with oxide of zinc in painting.

Combined with hydraulic lime, the silicate forms a good cement for fastening stones: united with fluor spar and powdered glass it becomes like porcelain or marble. Two parts of fluoride of calcium and one part of glass in impalpable powder must be made into a semi-fluid mass, with a solution of soluble glass of 36° Baume. This is applied to the parts which are to be joined, and the pieces are then pressed together until the cement is dry, which will be at the end of some days.

[6] *Journ. de Pharm. et de Chimie*, Fév. 1860, p. 117.
[7] *Comptes Rendus.*
[8] *Annal. der Chem. und Pharm.* Bd. cxii. s. 108.
[9] *Polytech. Journ.* Bd. clii. s. 44.

SCIENTIFIC NOTES AND QUERIES.

Utilisation of Spent Bark of Tanneries.—SIR,—In No. 10 of the CHEMICAL NEWS, p. 119, I observe a query as to the "Utilisation of the Spent Bark of Tanneries."

There is one purpose, for which it is extremely well adapted—the manufacture of a gas for heating or illuminating purposes. If the bark is submitted to destructive distillation in a small iron gas retort, the gaseous hydrocarbons, &c. are evolved in considerable quantity, and after being passed through milk of lime can be readily burnt from a jet. The quantity of gas obtained from the bark is so considerable that the expense is a mere trifle. In this condition it is well fitted for a means of heating, but from a deficiency of carbon possesses very slight illuminating power. This defect is easily remedied by passing the gas through naphtha, or some such substance, previous to its combustion, when a gas capable of giving a very brilliant light is procured. On account of the extreme simplicity of the apparatus needful for the production of this gas it appears to be a process in every respect adapted for employment in the country or in private houses.

The destructive distillation of wood for the manufacture of an illuminating gas has, I believe, been employed in some parts of Germany.—*W. Procter, M.R.C.S.*

Bloom on Gutta-percha.—Can any of our correspondents favour us with some information on the subject of the "bloom" which is so often to be seen on the surface of manufactured gutta-percha. A valued correspondent is desirous of investigating its chemical properties, and wishes to know if an ounce or two of the powder can in any way be placed at his disposal.—ED.

LABORATORY MEMORANDA.

Estimation of Mixtures of Acids or Alkalies in Solution.—SIR,—In No. 9, p. 108, of the CHEMICAL NEWS, a method was given for the above purpose. The mode of proceeding was to neutralise a given weight of the mixture of acids with some base, and another portion, of the same weight, with another base, and so on, using as many bases as there are acids in the mixture. It was asserted that there could be obtained by this means as many equations as there were unknown amounts of acid in the mixture. These were to be solved by the usual methods for equations containing more than one unknown quantity. It is necessary for the solution of such equations, that they should be quite distinct, and incapable of being derived from one another; otherwise the equations are in reality the same. In the case before us, having determined the amount of one base required to neutralise the mixture, the amount of any other base necessary for the same purpose is easily calculated. These equations would therefore be useless for the purpose stated.—*A. Reynolds.*

MISCELLANEOUS.

Duty on Chloroform.—Messrs. Smith and Co. of Edinburgh have sent the following letter to the Chancellor of the Exchequer. The subject of it is well worthy the attention of the makers of chloroform. If the duty on French chloroform be remitted, most certainly a drawback should be allowed on the spirit used in its manufacture here.

"Sir,—As manufacturers of chloroform, permit us respectfully to point out to you, that the proposed remission of the import duty on this article, if carried into effect, must extinguish the manufacture of the pure chloroform in this country. A very few words, we think, will prove this:—Pure chloroform requires, as the chief material of preparation, spirits of wine. The cost of spirits of wine 60° O. P. on the Continent and in America, where there is no excise duty on it, is about two shillings and sixpence per imperial gallon; in Great Britain, however, where there is a heavy duty on spirits for revenue, the price is about seventeen shillings per imperial gallon. The great difference between these two prices, in an article *essential* and so *largely necessary* to its manufacture, renders protection not only indispensable, but nothing more than justice to the British manufacturer. It is true, we and others in this country now possess the privilege of using the methylated spirit, but the chloroform from that is used for varnishes, and only medicinally as an outward application, and not by the medical profession for inhalation, for which purpose chloroform is manufactured from pure unmixed spirits of wine. But more than this, as the foreigner can buy pure unmixed spirits of wine cheaper than we in this country can buy methylated spirit, and again, as the yield of chloroform from the latter spirit is less by a good deal, it surely must be plain and undeniable that even the manufacture of this chloroform will also be put down here. The foreign manufacturer will be in a position to introduce into our market (for cost of transit will be more than covered by a less cost for labour) a superior chloroform at a less price than a home manufacturer can offer an inferior one. Should the present import duty on chloroform be abolished, the country that gave birth to the use of chloroform as an anæsthetic, it thus appears, will be in future deprived of its manufacture, and have to draw its supplies from abroad, solely to the advantage of the foreign manufacturer. These remarks could be greatly extended, but, knowing the value of your time, we forbear, confidently trusting that this plain statement of a few facts may prove sufficient for the retention, as originally felt to be, for the imposition of the import duty as an admittedly fair protection, in the circumstances, to the manufacturers of chloroform in our own country."—We are, &c. T. & H. Smith & Co.

The Right Hon. W. E. Gladstone."

The Electric Light applied to Surgery.—One of the greatest obstacles to the success of a surgical operation is the scanty and imperfect light which, in some cases, is the surgeon's only guide, and is fraught with danger to the patient. Thus the extirpation of a naso-pharyngian polypus is almost performed in absolute darkness, it being impossible to bring a common light near enough to the patient without scorching him. The problem, therefore, of finding a light which might be introduced into a cavity with impunity, remained still to be solved; and from a communication sent in a few days back to the Academy of Sciences by MM. Th. Dumoncel, Fonssagrives, and Ruhmkorff, it would appear that this desirable object has at length been attained. Dr. Fonssagrives having long entertained the idea that the electric light might be advantageously applied to the purpose, communicated his views to M. Dumoncel, a distinguished electrician, who calling to mind the effects of electricity *in vacuo*, as exemplified in Geissler's tubes, which although traversed by the electric light reveal no increase of temperature, conceived the following plan for turning this circumstance to account in surgical cases of the nature alluded to. A glass tube, having a very small bore, is bent into the form of a helix or screw (the smaller the bore, the greater is the brilliancy of the light); by this means, a kind of luminous cylinder is formed, which is sufficiently small to be conveniently introduced even into a narrow cavity. Thus the first part of the problem was solved; but the colour of the light was yet to be determined, since this depends on the nature of the gases introduced into the tube. As mixtures of certain gases, such as carburetted hydrogen, carbonic acid, hydrochloric acid, &c. will produce a white light, nothing remained but to fill the tube with such a mixture; and this delicate operation was intrusted to M. Ruhmkorff, who at the same time introduced other valuable improvements into the apparatus. The latter has since been successfully tried in various dental and other operations.

Poisonous Toys.—Very dangerous presents are often made to children. It is the peculiar happiness of juveniles to test, in many homely ways, the strength, flavour, and combustibility of of whatever toys are placed in their hands. The tendency to apply the tongue to all painted toys affords a temptation which only the strongest-minded children can resist; and licking the face of a favourite doll, or the surface of a painted ball, appears to afford pleasure which few can forego. Remembering these infantile idiosyncrasies, kind mammas and generous uncles should endeavour to ascertain that such coloured toys as they give are not painted in mineral colours. Very serious accidents—if we mistake not, deaths—have occurred from licking the aërial bladders which were recently so popular in the nursery. Many of them were painted with arsenical pigments. A sad accident, which occurred this week, at Lyons, points to another favourite toy as a possible source of the most serious misadventure. The "concierge" of the theatre there had presented a box of paints, as a new year's gift, to his son, a boy of about ten years of age. The little fellow was highly delighted with his new acquisition, and passed the whole evening in colouring a large portrait of Garibaldi. Most probably he wetted his pencil or his paints with his tongue; for, in the middle of the night, he was attacked with a violent colic, and died in a few hours, evidently from poison. In the same way the drastic purgative properties of gamboge are not uncommonly developed to a very unpleasant extent. The unfortunate event above described affords an important caution, which will not, we hope, be lost in England.—*Lancet.*

The Administration of Poison.—Sir George Cornewall Lewis and Mr. Clive have introduced a bill into the House of Commons, providing that any person maliciously administering poison with intent to endanger life or inflict grievous bodily harm shall be guilty of felony, and be liable to penal servitude for any period not exceeding ten years, and not less than three years, or to imprisonment for any term not more than three years, with or without hard labour at the discretion of the court. Any person maliciously administering poison with intent to injure, aggrieve, or annoy any other person, will be guilty of a misdemeanour, and liable to imprisonment not exceeding three years, with or without hard labour at the discretion of the court. The costs and expenses of the prosecution of any such misdemeanour may be allowed by the court as in cases of felony. If, upon the trial of any person charged with the felony, the jury shall not be satisfied that such person is guilty thereof, but that he is guilty of the misdemeanour, then the delinquent will be liable to be punished in the same manner as if convicted upon an indictment for the misdemeanour.

The Administration of Poison Bill was read a third time, and passed the House of Commons on Wednesday last.

The Adulteration of Food Bill was in Committee on Wednesday, and the three first clauses were agreed to.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Messrs. Silliman and Dana's courteous request shall be attended to immediately.

H. K. B.—Addresses are given in confidence. We shall be happy to forward a communication to *W. G. P.*

W. H. (Tillydesk)—Our correspondent has misunderstood us. We did not intend to republish the article in question. The process is only available for the separation of phosphoric acid in one condition.

W. J. J.—1, Copal and anime varnishes are made with spirits of wine, and the copal is burned for a few seconds, which makes it more soluble. A mixture of sandarac and mastic is said to increase the solubility of copal. 2, Nothing better than soap and water, and sometimes a little alkali.

A. W. P.—For the oxyhydrogen lime-light see page 152. The Fitzmaurice light soon.

L. Greg.—The arsenic sold is *arsenious acid.* A very few grains are sufficient to poison a man. We hope our correspondent has no evil intentions.

W. Sale—We believe the book was published by Messrs. Chambers of Edinburgh. The same information will be found in most works on chemistry.

E. H. (York)—The tannate of alumina is prepared in the same way as the tannate of bismuth. (See p. 137.) Rub together equivalent proportions of freshly precipitated alumina and tannic acid.

A. B.—Make them hot.

P. H. Hemschikoff—received.

Mr. Salter—received with thanks.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

Vol. I. No. 14. — March 10, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Organo-metallic Radicals, by M. Auguste Cahours.

(*Concluded from* p. 147.)

Oxide of Stannethyl. — When an alcoholic solution of iodide of stannethyl is poured into a solution of ammonia diluted with an equal volume of alcohol, oxide of stannethyl separates as a gelatinous mass. An excess of ammonia and caustic potash redissolve it. In order to obtain it perfectly pure the gelatinous mass is thrown on a filter and washed successively with hot water and boiling alcohol, until the washings no longer contain either the iodide or ammonia. The product is then dried first on water bath and then in vacuo. So prepared oxide of stannethyl is an amorphous white powder, insoluble in hot and cold water, alcohol and ether. It dissolves easily in hydrochloric, hydrobromic, hydrofluoric and hydriodic acids; and these solutions by spontaneous evaporation deposit beautiful prismatic colourless and odourless crystals of the chloride, bromide and iodide and fluoride of stannethyl.

Boiling acetic and formic acids give with oxide of stannethyl viscous products, which on cooling form a crystalline mass. These substances dissolve in hot alcohol, and by evaporation separate in the form of colourless tables. Butyric and valeric acids behave in a similar way.

A dilute and boiling solution of tartaric or citric acid dissolves oxide of stannethyl, and on cooling deposits small prisms of tartrate and citrate of stannethyl. Oxalic acid forms an insoluble compound with oxide of stannethyl.

Nitric and sulphuric acids, especially when hot, dissolve the oxide easily, and the evaporation of the solutions gives crystallised products.

Dilute solutions of potash, soda and caustic ammonia do not dissolve oxide of stannethyl, nor do they decompose it. When however the oxide is distilled with an excess of caustic potash, it is split up into a very volatile product, which may be condensed at a very low temperature in the form of beautiful colourless prisms, having a powerful odour and a strongly alkaline reaction on reddened litmus paper. This is the oxide of sesquistannethyl: there is formed beside some stannate of potash. The reaction is easily explained by the following equation:

$$3(SnC_4H_5O) + KO = SnO_2KO + Sn_3(C_4H_5)_3O.$$

Perchloride of phosphorus with the aid of a little heat quickly attacks the oxide of stannethyl. On distillation a fuming liquid may be condensed in a well-cooled receiver, from which thin crystals deposit. Water decomposes the liquid part, which is oxichloride of phosphorus, but does not attack the crystals. These may be purified by repeated washings with cold water, pressing between folds of filtering paper, and recrystallisation from alcohol, and then present the properties and composition of chloride of stannethyl. The preceding reaction may be explained by the following equation:

$$2(C_4H_5Sn\,O) + PCl_5 = PCl_3O_2 + 2(C_4H_5SnCl).$$

All the salts formed by stannethyl when they are soluble crystallise with facility. Heat decomposes them either partially or completely. In all the distillations the same acrid odour is observed, like that of essence of mustard, which characterises sesquistannethyl and its various combinations.

Sesquistannethyl Series. — We have seen that by the action of iodide of ethyl on tin there is formed besides the solid and crystallisable iodide an oil with a powerful acrid odour, a larger proportion of which is obtained when an alloy of tin and sodium is used in the place of pure tin.

When purified by rectification the oil (which is the iodide of sesquistannethyl) possesses the following properties. It is a heavy liquid, either colourless or of a pale amber. It boils without undergoing the least alteration between 235° and 238°. Its density is 1·833 at 22°. It is easily soluble in alcohol and ether, and only slightly soluble in water.

When cold it dissolves iodine without change, but when heated the iodine disappears. By continuing the addition of iodine, the solution soon ceases to be decolorised, and there is formed an etherial liquid which boils under 100°, and which has all the properties of hydriodic ether. On cooling the liquid becomes a mass of crystals which may be purified by pressing between folds of blotting paper and crystallisation in alcohol. In this way we obtain beautiful colourless prisms which are no other than the iodide of stannethyl.

Oxide of Sesquistannethyl. — An aqueous solution of caustic potash decomposes iodide of sesquistannethyl with the formation of iodide of potassium and oxide of sesquistannethyl, which dissolves in an excess of the alkali. When distilled this mixture yields oxide of sesquistannethyl and water. The aqueous solution serves for the preparation of the salts: the mass which solidifies on cooling the receivers may be purified by pressing in blotting paper and fresh distillations. So purified the product presents itself in the form of brilliant colourless prisms, which fuse between 44° and 45°, and distil at 272°. Water, alcohol, wood spirit, acetone and ether dissolve it easily. If kept for some time at a temperature near its boiling point water is disengaged, and the anhydrous oxide is obtained in the form of a limpid oil. The crystals then are an hydrate, which is proved by allowing water to fall drop by drop on the oily matter.

The aqueous solution has strongly alkaline reactions; it turns the syrup of violets green, restores the blue of reddened litmus paper, and saturates the strongest acid. When hydrochloric acid is brought near the oxide in a state of fusion, thick fumes are produced.

The salts formed by the oxide are nearly all soluble, and crystallise with the greatest facility: all have a strong acrid odour. The chloride, bromide and iodide of

sesquistannethyl are liquid, and have a strong acrid smell which resembles that of mustard.

The composition of oxide of sesquistannethyl is expressed by the formula:

$$Sn_2(C_4H_5)_3O.HO.$$

Action of Tin on Iodide of Methyl. Stanmethyla.—The iodide of methyl in contact with tin or an alloy of tin and sodium furnishes results exactly corresponding to those obtained with the iodide of ethyl.

When the iodide of methyl is heated with pure tin in a sealed tube to between 150° and 160°, the metal disappears in about 12 or 15 hours, if 3 parts of the iodide are used to 1 of tin. On cooling the tube a brown liquid is obtained which sometimes deposits magnificent crystals of a sulphur-yellow colour. Submitted to fractional distillation the liquid begins to boil about 50°, when a small quantity of unchanged iodide of methyl passes: the temperature then rises gradually, and the last portion passes over towards 230°. The greater part of the product distils between 180° and 230°. The residue left in the retort is red iodide of tin. The rough product of this first distillation deposits on standing a considerable quantity of the sulphur-yellow crystals mentioned above. The supernatant liquid from the crystals submitted to a new rectification begins to boil at 180°, and the distillation is finished at 230°. Towards the middle of the distillation the liquid becomes turbid and the red iodide of tin is separated. The product of this second distillation still deposits after some hours rhombohedral crystals. The liquid is separated from these and submitted to a third rectification, care being taken to collect what passes above 200° in a separate receiver. From this a considerable quantity of yellow crystals is deposited. To purify these the different deposits are collected together and pressed between blotting paper until they cease to stain it. A saturated solution of them in a mixture of alcohol and ether is then made, filtered, and allowed to evaporate spontaneously over strong sulphuric acid under a bell glass. The evaporation should be carried on in the dark, or the crystals will be of a brown colour. In this way we obtain oblique rhomboidal prisms of considerable size and perfect clearness, but which become opalescent in the air. They melt at about 30° into a liquid having the appearance of melted sulphur, which by slowly cooling becomes a mass of beautiful rhomboidal prisms. The product has a constant boiling point of 228°. Its density at 22° is 2·872. The crystals dissolve in water, especially when warm, alcohol, and wood spirit; acetone and ether dissolve them in considerable quantity. The alcoholic solution is decomposed by the sulphate, nitrate, acetate, &c. of silver, with the formation of iodide of silver, and the corresponding salts of the oxide of stanmethyl.

Ammonia decomposes a solution of these crystals, and gives a white amorphous precipitate of oxide of stanmethyl, insoluble in an excess of the precipitant, and presenting the greatest resemblance to the oxide of stannethyl. On analysis results were obtained which conducted to the formula: C_2H_3SnI.

2C	12		5·97
3H	3		1·49
Sn	59		29·35
I	127		63·19
	201		100·00

The crystallised compound is therefore the iodide of stanmethyl, homologous with the iodide of stannethyl formed under similar circumstances. The product boiling between 180° and 200°, rectified several times until it no longer deposited the red iodide of tin, yielded finally a colourless, limpid, very mobile liquid, possessing an acrid odour resembling that of mustard, but less penetrating than the smell of the iodide of sesquistannethyl. It remained liquid in a mixture of ice and salt, but solidified immediately in a bath of solid carbonic acid and ether. Its density at 18° is 2·155: it boils between 188° and 190°. It is but slightly soluble in water, but dissolves in all proportions in alcohol and ether. Potash decomposes it, forming iodide of potassium and a corresponding oxide, which is soluble in an excess of the alkali. When this solution is distilled, vapour of water passes over, carrying with it some of the oxide, which may be condensed in a cooled receiver. It is a colourless oil with a very strong smell, which at a low temperature becomes solid in the form of prisms of remarkable beauty. When analysed results were obtained which agree with the formula $Sn_2(C_2H_3)_3I = Sn_2C_6H_9.I$. In its composition and properties this compound exactly corresponds to the iodide of sesquistannethyl.

Oxide of Stanmethyl.—This compound is obtained by decomposing a solution of the iodide of stanmethyl with an excess of ammonia, throwing the precipitate on a filter, washing with very dilute alcohol, and then with pure water, until there is no longer a precipitate with nitrate of silver. The product carefully dried forms an amorphous white powder, tastless, insoluble in water, alcohol, ether, and alkaline solutions. Heat decomposes it, giving off a strong penetrating odour, due to the formation of oxide of sesquistanmethyl. By distillation with an excess of caustic potash, it is also decomposed, like its homologue the oxide of stannethyl, the oxide of sesquistanmethyl passing over with the water, and stannate of potash remaining in the retort. This reaction is explained by the following equation:

$$3(C_2H_3SnO) + KO = SnO_2.KO + Sn_2(C_2H_3)_3O.$$

Hydrochloric, hydrobromic, and hydriodic acids easily dissolve the oxide of stanmethyl, and the solutions evaporated give perfectly defined crystals. Sulphuric, nitric, formic, acetic, butyric acids, &c. form with it compounds which crystallise in a remarkable manner; the sulphate in particular furnishes large crystals of great beauty.

The salts formed by the oxide of sesquistanmethyl are nearly all soluble, crystallise easily, are volatilised without undergoing alteration, and have a strong smell like that of the iodide. They are isomorphous with those formed with the oxide of sesquistannethyl.

From the preceding history of the stannethyls and methyls, it is seen that tin forms with methyl and ethyl three definite compounds:

SnE	$SnMe$
Sn_2E_3	Sn_2Me_3
SnE_2	$SnMe_2$

which correspond with the oxides of tin

$$SnOSn_2O_3SnO_2$$

The two first terms of the series can fix oxygen, chlorine, iodine, &c. to form compounds like those which tin itself forms, and may be separated intact from these combinations, thus behaving exactly like a simple body as long as the equilibrium of their molecule is not affected. The last term of each series, *distannethyl* and *distanmethyl*, cannot unite with oxygen, chlorine, or their analogues, inasmuch as this term represents the limit of saturation for the combinations of tin. If submitted to the action of these bodies, they lose methly or

ethyl, (which is disengaged in the form of oxide or chloride) at the same time passing to the state of mono- or sesqui-stannethyl, &c. substances which not having attained the limit of saturation, can contract alliances with chlorine, iodine, bromine, &c. and so produce the compounds we have studied.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, 1 *March* 1860.

DR. A. W. MILLER, *in the Chair.*

MR. RILEY read a paper *On the New Zealand Iron Sand.* The New Zealand Iron Sand, from its fine state of division and richness, induced the author to make use of it for some experiments on the reduction of iron ores with various matters; and as titanic acid had not been tested for in the analysis published (CHEMICAL NEWS, p. 116), it was thought necessary to see whether it was present. 60·25 grains of the finely powdered mineral were therefore treated with hydrochloric acid, containing a little nitric; although it was boiled for some time, complete solution of the iron could not be effected (this was afterwards found to be due to the ore not being sufficiently pulverised, as it was found to be completely soluble in a very short time in strong hydrochloric acid, if in an impalpable powder). The solution was diluted with water and allowed to stand all night; it did not get clear, and great difficulty was experienced in filtering it. The filtrate evaporated to dryness left a residue upon redissolving in hydrochloric acid, of 3·71 grains, slightly coloured with peroxide of iron. This was fused with bisulphate of potash, treated with cold water and slightly warmed; complete solution could not however be effected without the addition of some sulphuric acid. On boiling a considerable precipitate was obtained; the whole of the titanic acid could not be completely thrown down unless some of the large excess of acid was neutralised (still leaving however the solution very distinctly acid), the precipitate, on testing with microcosmic salt, gave the distinct reaction of titanic acid. The residue insoluble in HCl was tested for titanic acid, and found to contain a considerable quantity. The sample employed in some of these experiments is the same that was analysed and the results given in CHEMICAL NEWS, p. 116.

I. 18·08 grains of ore dissolved in nitro-hydrochloric acid gave a residue of 1·17 grains. The filtrate, evaporated to dryness and heated, gave a residue on resolution in hydrochloric acid of ·60, which was slightly coloured with peroxide of iron. The filtrate from the latter, evaporated to dryness and re-dissolved, still gave a residue of titanic acid. Two other trials were made to see if titanic acid could be separated by evaporating to dryness; the results were however most unsatisfactory, and the method was therefore abandoned.

Two portions of ore were weighed out and dissolved in hydrochloric acid.

I.	18·08	gave 1·17	residue insol. in HCl	=	6·47 per cent.
II.	19·31	„ 1·24	„ „	=	6·42 „
III.	19·83	„ 2·41	„ „	=	12·15 „

Portion No. II. was not submitted to the action for more than 20 to 30 minutes: complete solution was effected in that time.

No. III. was heated for one or one and a half hours on th sand bath, until about half the original quantity of acid had been evaporated off. Some of the titanic acid was evidently separated and became insoluble by this method.

Residue II. was fused with bisulphate of potash, dissolved in warm water, and some sulphuric acid added. All the titanic acid appeared to dissolve, leaving a siliceous residue, which was filtered off: it weighed ·87; treated with hydrofluoric acid and sulphuric acid ·48; difference equal silica, ·39.

No. III. residue treated with hydrofluoric acid and sulphuric acid, gave a residue of 1·88.

Percentage of silica in	No. I.	.	.	.	2·02
„	No. II.	.	.	.	2·67

The above sample was not the same as that analysed, the results of which were given in CHEMICAL NEWS, p. 116.

An experiment was made on a solution of titanic acid in bisulphate of potash to see whether it behaved similarly to peroxide of iron and alumina with acetate of soda. It was found that titanic acid was completely separated by boiling with acetate of soda, no precipitate being produced on testing the filtrate with ammonia. The solution of No. II. was therefore treated as in the analysis of iron ores, viz. acetate of soda was added, and it was then boiled; no difficulty was experienced in washing, and the separation of the titanic acid was complete; no precipitate being produced in the filtrate by ammonia. The basic peracetate of iron, &c. was dissolved in HCl, and precipitated by ammonia and weighed. The weight obtained was 18·81 grains. The filtrate from the precipitate by ammonia gave no precipitate on evaporating nearly to dryness. The 18·81 grains treated with hydrochloric acid left a brown powdery residue, which by long boiling appeared to dissolve to some extent, and was evidently titanic acid coloured with iron. This had not been examined further.

Upon determining the iron direct by means of a standard solution of bichromate of potash, the mean of two determinations for obtaining the value of the standard solution showed that 1000 grains by measure of the solution = 4·996 grains of iron.

In the iron ore:

				Per cent. of iron.
A.	18·60 grains required	2120 measures of the solution	=	56·94
B.	19·63 „	2244 „	„	= 57·11

Giving a mean result of 57·03 per cent. of iron.

In two other determinations, viz. in (A′.) iron sand from Mr. Ridgway, Leicester Square; (B′.) iron sand from a friend in Monmouthshire:

				Per cent. of iron.
A′.	18·26 grains required	2116 measures of the solution	=	58·99
B′.	20·59 „	2367 „	„	= 57·43

The amount of titanic acid, alumina, and phosphoric acid may be determined thus:

Iron Sand.	Iron.	Iron Sand. Portion II.	Iron.
100	: 57·03	:: 19·31	: 11·01.

∴ Portion II. gave by calculation from A and B results,

11·01 Fe = 15·73 Fe_2O_3

Portion II. gave,

18·81 Fe_2O_3, TiO_2, AlO_3, and PO_5 (if present).

∴ 18·81 − 15·73 = 3·08

3·08 being chiefly, I believe, TiO_2.

The percentage of protoxide of iron is in excess of that requisite to form Fe_3O_4. Thus:

18·6 of ore gave 773 measures same stand. = 26·69. per cent. of FeO.

The ore was dissolved in a flask in an atmosphere of carbonic acid and filled up with cold boiled distilled water, the FeO then determined by standard solution.

Mr. Riley intended to present to the Society a complete analysis; circumstances however prevented this, and he trusted the necessity of correcting an error would be a sufficient apology for presenting such imperfect results.

DR. GLADSTONE said that in the analysis given in the short mineralogical paper referred to above, he had simply followed the course usually adopted in such cases, and thus had overlooked the presence of titanic acid. Dr. Noad had since pointed out to him the fact that some samples of New Zealand iron sand contained that substance; whereupon of course he saw the necessity of repeating the analysis, and of withdrawing his communication if his sample was found to contain titanic acid. He had not been able to turn to the matter till the previous day; but on a somewhat hasty

analysis of his specimen, he had succeeded in finding a trace of titanic acid in the insoluble portion, and just one per cent. in the soluble portion—not the larger amount mentioned that evening. He confirmed the observations on the difficulties attending the examination of ilmenite, and the estimation of titanium, and pointed out several directly contradictory statements in works of standard reputation as to the solubility and other properties of titanic acid. He hoped Mr. Riley would be able to reconcile these, and to induce chemists to search for this substance in places where it was not now suspected. The paper was accordingly withdrawn.

Dr. Hofmann then made a verbal communication, an abstract of which we hope to give next week.

At the last meeting of the council of the above Society, the following arrangements for future evenings were decided upon:

On Thursday, April 5, Dr. Thomas Andrews, M.D. F.R.S. M.R.I.A. will deliver a discourse *On Ozone.*

On Thursday, May 3, Dr. J. H. Gladstone, Ph.D. F.R.S. will deliver a discourse *On Circular Polarisation.*

On Thursday, June 7, Dr. Frankland, F.R.S. will deliver a discourse *On Organo-Metallic Bodies.*

In addition to the above, the Society will meet as usual on the evenings of March 15, April 19, May 17, and June 21. Whenever practicable, the titles of the papers to be read or the subjects of discussion at any of the meetings will be previously announced in the Chemical News.

The next meeting will be held on March 15, when there will be a paper read on the *Platinid-cyanides* by Mr. Hadow, and on a new *Ammonio-chrome compound.*

PHARMACEUTICAL SOCIETY, 7 *March* 1860.

T. N. R. Morson, *Esq. President, in the Chair.*

The following papers were read, which, by the courtesy of the authors, we are able to give at greater length than usual.

On Syrupus Ferri-phosphatis, by Mr. Schweitzer.

The several difficulties experienced in obtaining this syrup according to the formula given by Mr. Greenish in the *Pharmaceutical Journal*, vol. xii. p. 311, the vagueness of this form and some peculiar properties of the phosphates of iron induced the writer to try a series of experiments, the result of which he is induced to publish.

Before entering into a discussion on this subject, it may be as well to point out those objections which the syrup usually offers.

1. The syrup is either too acid; or
2. The phosphate of iron is from the commencement in an insoluble condition;
3. The syrup is bright at first, but soon becomes turbid;
4. Or the permanent solubility of the phosphate of iron is due to the presence of a foreign salt.

In dissolving the dry perphosphate of iron such as Mr. Greenish's form would lead us to select, we find that a very strong, usually glacial phosphoric acid is required for effecting its solution; and that heat instead of assisting, either prevents the solution, or precipitates the dissolved phosphate of iron. In mixing, moreover, such a cold prepared strongly acid solution with the requisite amount of simple syrup, the result will still be very acid, and if bright at first, soon becomes cloudy and throws down part of its iron. The addition of dilute sulphuric or hydrochloric acid, or a citrate of ammonia, soda or potash, delays and even prevents the precipitation of the phosphate of iron; but as such an addition has always to bear a certain proportion to the amount of iron and excess of phosphoric acid in the syrup, this becomes objectionable, especially as we may arrive at the same result without it.

After various trials it was found that fresh precipitated moist phosphate of the protoxide of iron gave the most satisfactory results, and at the same time led the writer to suggest a new, and as he hopes, more definite and explicit mode of making the *Syrupus Ferri-phosphatis.*

A solution of the tribasic phosphate of the protoxide of iron is selected as the base of the syrup, which is made according to the following form. Take of

Sulphate of iron in crystals	℥iij
Phosphate of soda	℥iij
Carbonate of soda	℥ss
Water	℥ss
Phosphoric acid, Ph. L.	fl℥xxj

The phosphate and carbonate of soda are pounded together in a mortar, and when fine the sulphate of iron is added and the trituration continued, gradually adding the ℥jss. of water till a uniform fine blue mass is produced. This when well washed is thrown on a filter, drained, and while moist introduced into a glass measure; it should occupy rather less than 6 fluid ounces, and if less the deficiency should be made up with distilled water. These 6 ounces of fresh precipitate are mixed and dissolved in 21 fluid ounces of dilute phosphoric acid of Ph. L. and the resulting solution filtered and kept for use.

Five fluid ounces of this solution when mixed with 9 fluid ounces of simple syrup, produces a *syrupus ferri-phosphatis* containing 1 grain of phosphate of iron and about 16 minims dilute phosphoric acid in a fluid dram. The above amount of iron is considerably larger than that actually found in Mr. Greenish's syrup.

The formation of the phosphate of iron, its subsequent washing and solution in phosphoric acid, and the addition of syrup to the solution — all these operations have to be effected without the application of heat.

The above form for the preparation of the phosphate of iron with the addition of carbonate of soda is recommended, because the amount of phosphoric acid contained in a certain quantity of phosphate of soda is more than sufficient to combine with the iron contained in an equal quantity of of sulphate of iron: and as the soda in the phosphate is not enough to neutralise the liberated sulphuric acid, the excess of which (with the free acid always contained in commercial sulphate of iron), would cause the solution of and subsequent loss of a considerable amount of the freshly precipitated phosphate, the carbonate of soda is added, which will entirely prevent the loss.

On Syrup of Superphosphate of Iron and other Phosphates used in Medicine, by Mr. Samuel Gale, *F.C.S.*

(This paper will be given in our next number).

On the Preparation of Pyrophosphate of Iron by Mr. J. Robbins.

Among all the elementary bodies not one gives so large a number of beautiful and interesting preparations employed as remedial agents as iron; and were it not that the medical man has already so large a number at his command that he is somewhat perplexed in making his selection, the number might be increased almost *ad infinitum.* One of the most recently introduced curative agents is the so-called pyrophosphate of iron, a salt more beautiful in appearance than the ammonio-citrate or any other of the scaled salts previously in use. Its colour varies according to the mode of manufacture. It may be made of a greenish or decided green colour, or yellow, or even of a reddish tint. Water dissolves it readily. Its taste has little to indicate its ferruginous character, but is rather that of a pleasant saline, agreeable to the most fastidious palate.

The name given to the salt is decidedly objectionable. The science of chemistry within the last few years has made such rapid progress that there is scarcely a day but some new compound is announced to the scientific world, some with such long and formidable names that it requires more

courage than many possess to attempt even to pronounce them, while few memories can command them at pleasure. I think it therefore a pity when a new preparation is introduced of rather an indefinite composition that the difficulties already existing should be increased by giving it the name of a definite chemical compound well known. The salt in question physically bears no relation to pyrophosphate of iron, and all that can be said chemically is that this compound is one of its constituents.

Pyrophosphate or bibasic phosphate of iron is obtained by adding a solution of persulphate or perchloride of iron to a solution of bibasic or pyrophosphate of soda. It forms a white precipitate, quite insoluble in water and dilute acids. The pyrophosphate of soda is obtained by simply igniting to redness in a crucible the tribasic or ordinary phosphate of soda. The two phosphates of soda are best distinguished by nitrate of silver, which gives with the pyrophosphate a white, and with the ordinary phosphate a yellow precipitate. Recently precipitated pyrophosphate of iron obtained as above is readily dissolved by pyrophosphate of soda, and by the citrates of potash, soda, and ammonia. When pyrophosphate of soda is used as the solvent, and the solution is allowed to evaporate spontaneously in a warm place, a nice looking transparent salt is obtained, which however is nearly insoluble in water, evidently from some change having taken place during desiccation. The citrates of soda, potash and ammonia freely dissolve the pyrophosphate of iron, yielding salts readily soluble in water; but the soda citrate I find to give the most satisfactory results. With it an elegant preparation may be made, which is easily scaled, readily dissolved by water, and which when exposed to the air retains its brilliancy a much longer time than if prepared with the citrate of potash or ammonia.

To prepare this salt — the best name for which would be *citro-pyrophosphate of iron* — take citrate of soda dissolved in a small quantity of water, and with the assistance of heat dissolve in it as much of the recently precipitated pyrophosphate of iron as it will take up. Filter the solution, and evaporate to the consistence of a syrup. Lastly, spread on glass plates to dry, when beautiful scales of a greenish-yellow colour will be obtained. One part of dry citrate of soda is required to dissolve the pyrophosphate precipitated from one part of the pyrophosphate of soda free from water of crystallisation.

As it may be considered desirable to introduce as much bibasic phosphoric acid as possible into this preparation, the following formula may be preferred:—

Take of pyrophosphate of soda . .	1 part,
„ syrupy citrate of ammonia . .	1 part,
„ citrate of soda	2 parts.

Dissolve in them as much of the recently precipitated pyrophosphate of iron as possible, and proceed as before. The salt formed by this process is also a very elegant one, having a greenish hue, and being perfectly soluble. If a reddish tint be desired, it can be easily obtained by the addition of the smallest quantity of ammonio-citrate of iron to the syrupy solution. One of the chief points of success in scaling this preparation is to take care that the glass plates are not subjected to a temperature much above summer heat.

The Chairman said that the papers which had been read were valuable contributions, although they contained nothing which could be said to be new. The syrup of the phosphate or superphosphate of iron, for it was sometimes called by one and sometimes by the other name, though strictly speaking it was a superphosphate, had long been prepared by dissolving freshly precipitated phosphate of iron in a clear syrupy phosphoric acid. The pyrophosphate was an elegant, tasteless, and valuable medicine, well worthy of attention. He thought it a pity that the compound syrups had been introduced. The meeting would be happy to hear any remarks from gentlemen practically acquainted with the making of these preparations.

Dr. Redwood made some remarks on the importance of uniformity in the preparations.

Mr. Waugh said that the syrup with nickel was largely used by Dr. Simpson in Edinburgh, and inquired of Mr. McFarlane for some information respecting it.

Mr. McFarlane said he came to London to learn.

Mr. Cook and Mr. D. Hanbury, Jun. gave an account of some articles called Pulu, Penawar-jambi, and other longer names. They all consist of the shiny hairs which grow on the rhizomes, and stems of various ferns found in the Sandwich Islands, in Batavia, Java, and Madeira. Pulu, the article from the Sandwich Islands, had become an important article of commerce. The quantity exported from the islands in 1851 was only 2000 lbs.; in 1858 it had increased to 213,000 lbs. The quantity obtained from one fern was only 2 or 3 oz., and the time necessary for the growth of this was four years. It was principally exported to San Francisco, where it was used for stuffing pillows and cushions. The ferns from which it is obtained are found on the highlands at an elevation of 2000 to 4000 feet, and they sometimes grow to the height of 15 feet. The article from Java had been introduced into medicine as a styptic.

Dr. Redwood then made an important communication on the subject of Hydrargyrum cum Cretâ, which the great length to which our report extends obliges us to defer until next week.

SOCIETY OF ARTS, 29 *Feb.* 1860.

George Godwin, *Esq. F.R.S. in the Chair.*

The attention of the meeting on this occasion, was devoted to a paper by Mr. G. R. Burnell, *On Building Stones*, the causes of, and means of preventing, their decay being especially considered. Mr. Burnell's communication was a very lengthy one, but we will endeavour to lay his views before our readers in a condensed form. In the first place, attention was drawn to the influence of local material upon the architecture of towns, the general style of London, and other places where bricks are almost entirely employed, being contrasted with that of Edinburgh, Bradford, Paris, &c., where stone is cheap and abundant. A general classification of the building stones used in the metropolis followed, and the distinctive characters of the freestones, and of those requiring picks and wedges to work them, were severally pointed out. The chief sources of granite and its allies were thus enumerated:

"The London market consumes large quantities of granite from the Channel Islands, Cornwall and Devonshire, Mount Sorel in Leicestershire, Aberdeen and Peterhead in Scotland. The whinstones, basalts, and volcanic tufas, are hardly ever seen here — unless in the form of the pozzuolanos and trap, which are occasionally imported from Italy and Germany for making artificial hydraulic cements — whilst the quartz rocks and the quartzose sandstones, the mica schists, &c. are never used. The quartzose conglomerates, such as the Bramley Fall stone, are occasionally employed in engineering works, and the tertiary grès, or sandstones, of Windsor forest are used in the neighbourhood of Windsor as paving materials for streets and stables, just as the grès of Fontainebleau, their geological analogues, are used in Paris."

The Lecturer said that the advantages of this class of materials consists in their great hardness, density, and impermeable nature, while the objections to their use are the cost of working, which is very high, and the heterogeneous composition they generally exhibit,—a fruitful source of decay. Speaking of the cause of such disintegration, he observed, "the Cornish and the Devonshire granites, and some of the porphyries and elvans from those counties, frequently contain a notable proportion of felspar; and when they are exposed to the action of rain-water, containing (as it usually does) carbonic acid in solution, that felspar decomposes, and is then easily removed, leaving the quartz and the mica in relief

without any cementing material. Illustrations of this mode of decay may be observed in the granite used in parts of Waterloo or London Bridges, or in the granite piers of the crypt under the hall of Christ's Hospital; but the process is very slow, and it would seem to be subject to some laws not hitherto discovered, for the decay of the felspar does not take place according to any known rules. The more crystalline, in fact, the felspar of any of these bodies may be, the more perfectly does it resist the decomposing action of the atmospheric agents; and we shall have occasion again to allude to the influence of this mechanical state of natural substances upon their durability. In the meantime it may be added, that in the Bramley Fall and in the analogous stones, the siliceous conglomerates, the same phenomena may be observed. The cementing material frequently decomposes, and is washed away from the ingredients it naturally held together, and then the latter as certainly fall asunder, or the cementing material decays, and in so doing it produces a dangerous disintegration of the mass. It follows from these observations that the smaller and the more uniform in dimensions the materials of these heterogeneous rocks may be, the greater is the probability of their duration, and in the case of granite especially it is essential to select those descriptions which do not contain large crystals of felspar. It is singular that some of the granites of Normandy, Brittany, and the north of Spain, present identically the same mineralogical peculiarities as the granites of Devon and Cornwall, and they are equally susceptible of decay. The varieties in the lithological characteristics of the Bramley Fall stone, and in those of the quartzose conglomerates are still more hard to define than even those of the plutonic rocks; in the same quarry, and even in the same bed, the qualities of these stones will change within a very small distance, and the great irregularities of this description of stone form in fact the most serious objection to its use. Nevertheless when the Bramley Fall or the siliceous conglomerates are well selected, they are extremely valuable for engineering purposes, on account of their hardness and of their power of resisting crushing weights. They yield to atmospheric influence when the siliceous cement exists as soluble silica, and is of an amorphous character; if on the contrary the cement assume a crystalline character, it becomes unattackable even by caustic alkaline solutions, and the siliceous conglomerates are then as durable as the best descriptions of granite themselves. Of the granites which are used in London, those obtained from Aberdeen, Peterhead, and Mount Sorel are the most valuable, but also, on account of their hardness, the most expensive."

Turning to the freestones most commonly used in London, the list runs thus:—"Amongst the sandstones, the Craigleith, the Dundee and Arbroath, the Yorkshire stones, and the sandstones furnished by the Wealden deposits near Tonbridge Wells, or by the subcretaceous formations of the neighbourhood of Godstone, Maidstone, or Folkestone; amongst the magnesian limestones, the Anston and Bolsover stones; amongst the carbonates of lime, the Portland, Purbeck, Ketton, Barnac, the Caen, Ranville, Aubigny stones, are to be met with in commerce without difficulty, whilst it would be easy to increase their number by the introduction of the remarkably valuable tertiary limestones of the Paris basin. In some localities even the common chalk becomes so indurated as to allow of its being used as a building stone; less frequently, it is true, in England than in France, for in the valley of the Lower Seine this material is extensively used in the best buildings, as at Rouen, Vernon, Louviers, &c." The sulphates of lime ("gypsum," "selenite," &c.) were then noticed as sources of "plaster of Paris," &c. as also were the various argillaceous limestones from which we obtain the "Roman" and "hydraulic" cements. Sandstones came next, but we shall content ourselves with a few figures merely from this part of the paper. The Craigleith stone, used largely in Edinburgh, is "composed of minute grains of quartz, with occasional plates of mica, united by a siliceous cement, containing usually about 98 per cent. of silica, 1 of carbonate of lime, and 1 of bitumenous and other miscellaneous ingredients. The weight of a foot cube of the Craigleith stone is about 146 lbs. and it is stated to resist a crushing weight of 5800 lbs. on the inch superficial." The Dundee and Arbroath stones offer no points of special interest; but the Yorkshire sandstones, with which London is paved, demand our attention for a moment. Here we note that their strength and density about equals that of the Craigleith; that although freely permeable to water frost has but little destructive action upon them in general, owing to the distinct and regular lamination, but that, nevertheless, they do not "stand well between wind and water," as when placed in basements or plinths of buildings. As instances of the diversity of results obtained with magnesian limestones, from the Anston and Bolsover quarries, the Museum of Practical Geology on the one hand, and the Lincoln's-Inn Library and new Houses of Parliament on the other, would be familiar to all. The oolites are far too important to be neglected, for ranged in this series we find the Barnack, Ketton, Ancaster, Portland, Bath, Caen, and other stones, with whose leading characteristics we are most of us acquainted. The Barnack, or more properly, the Casterton stone, for the original Barnack quarries have been long abandoned, is of a light-brown tint, its density being 2·09, while the weight required to crush it, is not more than one fourth of that demanded by the Craigleith stone. When carefully selected, the Barnack oolite seems to be very durable, as numerous structures in Cambridgeshire, Suffolk, and the Isle of Ely now amply testify. The Ketton stone presents a very similar appearance to the last-named, but is more difficult to work. In London, the tower of St. Dunstan's-in-the-East exhibits its capabilities in a favourable light. The Ancaster stone, commonly employed in the Midland Counties, has many recommendations, not the least of these being its pleasing appearance, and the facile manner in which it may be worked. The Isle of Portland furnishes the metropolis with one of its best building stones, although it is very variable. As regards durability, the samples obtained from the West Cliff quarries are habitually superior to those got from eastern workings. A cubic foot of the Portland oolite weighs ordinarily about 149 lbs. and its crushing load is approximately 3270 lbs. per inch super. For many purposes the upper beds are preferred, from the more crystalline character of the carbonate of lime, which acts as the cementing material of the whole. Somerset House and many city churches evidence the enduring nature of Portland stone. Mr. Burnell dismisses Bath stone with a very cursory notice—the restoration of Henry the Seventh's chapel being cited as an example of its decay. It weighs, we are told, about 123 lbs. per cubic foot, and may be crushed by from 1800 to 2000 lbs. on the inch. Caen stone — so called from the Norman town of that name near which it is dug — is a very beautiful material, easily cut and carved, weighing about 120 lbs. per foot cube, and capable of sustaining nearly 2000 lbs. on the superficial inch. The upper beds of the Caen quarries yield but small blocks, but these are of a more lasting nature than those obtained at greater depths, and the Lecturer regretted that the architectural requirements of the present day should lead to the abandonment of the really good stone for that of inferior quality and of larger size. He was of opinion too that many other Norman stones possessing valuable qualities had been as yet entirely overlooked by our builders. The Purbeck stones were lastly noticed, but without presenting any point of interest for our readers. Mr. Burnell then proceeded to consider the causes of decay in building stones, which he described as partly mechanical, and in part also chemical; the solvent properties of atmospheric moisture — the variations of temperature — the integral changes of the stones themselves, as being among the most important. It was pointed out that water holding free carbonic acid in solution would ever have a destructive influence upon stones, exposing the silicates of potassa or soda, and the carbonates

of lime, &c. to its influence, but at the same time the result is greatly modified by the mechanical characters of the material. As a rule those stones or portions of stones which are crystalline, do not give way so readily as those of more amorphous nature; *volcanic* or *plutonic* crystallisation being even more permanent than any other kind. From these premises it follows that stones of an irregular, porous and earthy texture should be exposed as little as possible in situations where rain-water may lodge or beat against them, denser and more crystalline materials being employed for such places. Great stress too was laid upon the necessity of placing all stones *bedwise*, to avoid as far as practicable, the disintegrating effect of frost, &c. The chemical reactions occurring internally were stated to be mainly those of oxidation and hydration of the various constituents of the stones; but as our author at this place gets somewhat out of his depth, he will perhaps excuse our following him into what he designates "this interesting but obscure branch of applied chemistry."

Further on, he observes:

"The actions sufficient to affect the stability of the compound of ordinary building stones, by reason of the new forms of matter they superinduce, may principally be considered to be those resulting from the absorption of the gases of the atmosphere, and especially the extraordinary process known by the name of 'saltpetering,' or more correctly speaking, of nitrification. This process displays itself in the formation of minute crystals, effloresing from the interior to the exterior of the stone, and it leads to the destruction of the exposed surfaces of the latter, through the gradual removal of the minute particles, in consequence of the disintegration produced by the expansive action of the crystals in process of formation."

The causes of "salt" efflorescences Mr. Burnell evidently considers among the *obscure branches*, as he vaults lightly over that part of his subject. We turn finally to the preservative processes now used, or recommended. Paints, at the best, have but a temporary value, since the coating does not long remain intact. The application of fatty or resinous matters seems to be effectual in some cases by filling up the pores of the stone or other material, and thus protecting it in a greater or less degree from the action of air and moisture. Mr. Burnell next considered the value of various silicating processes, more particularly those of M. Kuhlmann and Mr. Ransome, which are quite similar, with the exception that by Ransome's process the stone is treated with a second wash of chloride of calcium, whereby a hard and durable silicate of lime is formed at once. On the other plan, viz. the use of soluble silicates alone, the hardening process is a very slow one, depending upon the action of atmospheric carbonic acid, and a large part of the silicate of potassa or soda gets washed away in the interim. The Lecturer regretted that the stone for the Parliament Houses had been mainly chosen from the indication of Brande's test, which cannot always be depended upon, and believed Ransome's method of preservation to be the best hitherto proposed.

The Chairman, in inviting discussion upon the paper which had just been read, said that the subject it treated of was a very important one. He thought Mr. Burnell considered it more easy to distinguish between good and bad stone than is actually the case, and could have wished that he had dwelt more upon the numerous varieties and characters of the Bath stones. The new front of Buckingham Palace was a lamentable instance of inferior Caen stone, being in its present condition a constant source of danger and expense. He watched with great interest the effect of Ransome's process, of which he thought well.

Prof. Ansted confined his remarks to two points, the causes of decay and means of preservation. There could be no doubt that the decay of granite arose from the decomposition of felspar, those varieties containing soda being more liable to change than those where potassa replaces that base. Limestones were chiefly disintegrated from mechanical causes. The dolomite limestones varied greatly in their nature, as the relative proportions of the carbonates of lime and magnesia were different: so long as these stones were *crystalline* he considered them among the very best. The quarry from which the stone for the Houses of Parliament was first taken was unfortunately not in a condition to yield the required amount, so other quarries were had recourse to, with greatly inferior results. Sandstones, he said, depended upon the durability of their cementing material, and in common with many others should always be laid *bedwise*. The mode of preservation was an easy thing to talk about, but was very difficult to accomplish, as although moisture might be prevented from entering a stone, it could seldom be got dry in the first instance. The Professor alluded in detail to the mechanical effects of water, and the solvent action of carbonic and sulphurous acids, concluding his speech with a review of the silicating processes before mentioned, and expressing a high opinion of the durability of silicate of lime.

Mr. C. H. Smith's observations were chiefly for the purpose of defending the conduct of the Commissioners appointed to select the stone for the Parliament Houses, and of correcting some statements of Mr. Burnell on this subject. He thought that "saltpetering" must come from the brickwork behind, and not from the stone itself, as he had subjected limestones to severe tests with alkalies and salts, but little effect having been produced, as his specimens would show. We may here remark that the specimens in question were marbles or crystalline stones, and therefore, from these and other circumstances, we do not consider the experiments of the slightest practical or scientific value. Mr. Smith entirely distrusted analyses, and their indications in reference to the properties of stones, saying that "Nature found out means of decay which the most scientific chemist never thought of."

Mr. Robert Hunt wished to correct an error which the author of the paper and the previous speakers had fallen into, relating to the decay of granite. He was prepared to maintain that this was *not* due to the decomposition of the felspar. China clay was *not* produced from decomposed felspar, and as far as human observation could go, never had been true granite. He dwelt at length upon one cause of decay which had been overlooked, viz. the property of all porous bodies of condensing gaseous exhalations internally, referring especially to Prof. Graham's investigations on *osmosis*. After a few observations by Prof. Tennant and Mr. Warrington, a vote of thanks was passed to Mr. Burnell. Owing to the lateness of the hour Mr. Wentworth Scott did not detain the meeting by any further remarks, but embodied his views upon "salt efflorescences" in a letter to the Secretary.

CAVENDISH SOCIETY.

The Thirteenth Anniversary Meeting of this Society was held at the rooms of the Chemical Society, Burlington House, on Thursday the 1st of March, at 3 o'clock P. M.

The Master of the Mint, *President, in the Chair.*

The Secretary read the following Report of the Council.

In the last Annual Report, the Council stated that the thirteenth volume of Gmelin's *Handbook of Chemistry* was then in progress, and was intended as a book for 1859. The completion of this volume has occupied a longer time than was anticipated, partly in consequence of the editor having to wait for a portion of the German edition which is comprised in it, and partly in consequence of the extensive additions of new matter which had to be made in the form of appendix. It is now ready for distribution, and the large amount of matter it contains, will, it is hoped, compensate in some degree for the unavoidable delay that has occurred in supplying it to the subscribers.

The Council are unable to hold out the prospect of any other volume being supplied for 1859, and must refer to the statement made in the last Report for an explanation of the

causes which have contributed to limit the issue of books during the last two or three years.

The propositions, originating from several sources, which have been made with reference to works thought to be suitable for publication by the Society, and some of which were referred to in the last Annual Report, have received the attention of the Council, and have been fully discussed on repeated occasions. The conclusion to which the Council have arrived, after mature consideration, accords with the opinion expressed in the Report of last year, which is, that the whole of the resources of the Society should be concentrated upon the completion of the few remaining volumes of Gmelin's *Chemistry* before any other work is undertaken. This opinion, they have reason to believe, is also in accordance with that of the majority of the members of the Society. In the present state of the Society, the attempt to bring out any other work in conjunction with the *Handbook of Chemistry*, would necessarily retard the completion of the latter, as the means at the disposal of the Council are insufficient for the production of more than one large volume a year, while an apparently insurmountable obstacle is presented to the extension of the number of subscribers by the necessity imposed on new members to provide a large number of the preceding volumes of the work now in progress, in order to make their sets complete. Attempts have been made to overcome this difficulty, but without success; and even if, in other respects it were possible, the small stock of the early volumes left on hand, would so far limit the power of enlarging the Society in that way, that no sufficient increase could be derived to justify any material augmentation in the expenses of publication.

The present income of the Society, if maintained, will be sufficient to enable the Council to bring out what remains to complete the work of Leopold Gmelin as fast as it is produced by the German editors; and at the same time to add, in the form of an appendix, all new matter relating to those parts of organic chemistry treated of in the preceding volumes. The matter thus added to the volume now in course of distribution, occupies two hundred pages. These additions, which are made to each succeeding volume of the work, may be regarded as "Annual Abstracts of Papers on Chemical Science," which some of the members of the Society suggested to the Council, in a communication noticed in the last Report, as suitable for publication. The Council are glad to be enabled thus far to meet the wishes expressed by members, without retarding the progress of the work which all seem desirous to expedite, or involving the Society in liabilities beyond the current means.

A new part of the German edition of the *Handbook* has just appeared, the translation of which will at once be proceeded with, and there is every reason to believe that the supply of matter will be kept up, so as to admit of the publication of a volume, with the usual additions, or abstracts of papers, every year, until the completion of the work.

The preparation of an index to the whole of the volumes is now occupying the attention of the Council.

When Gmelin's work has been brought to a conclusion, a suitable opportunity will be presented for considering the course to be pursued with reference to the future. The obstacle to the extension of the Society, to which allusion has been made, will then cease to exist. New works may be undertaken, for the selection of which ample time will have been afforded. These may resemble in character the works previously produced, or it may be thought desirable to undertake works of a different description, which would attract a new class of members, and the extension or reconstruction of the Cavendish Society would be the probable result.

The Council feel, however, that they cannot too strongly impress upon the members the importance of retaining the support of all the present subscribers to the Society, until the work on which they have been so long engaged is brought to a satisfactory conclusion.

It was moved by Dr. Roscoe, the Local Secretary for Manchester, seconded by Mr. Daniel Hanbury, and carried unanimously: That the Report just read be received, approved, and adopted.

Before the report was adopted the meeting was addressed by Dr. Basham and another subscriber, who complained of the slowness with which the Society's books were published, and suggested that some smaller volumes might be issued while the publication of Gmelin's *Chemistry* was proceeded with, which would have the effect of keeping the subscribers together, and possibly of increasing the number.

They were replied to on the part of the Council by Dr. Longstaff and Mr. Maskelyne, the former of whom asserted that the difficulty was not so much financial as in finding suitable works to publish. The latter stated that he had entered the Council with just the same opinions as Dr. Basham, but on thoroughly investigating the affairs of the Society he had become convinced that it would not be safe to undertake any other work while the publication of Gmelin's *Chemistry* was in progress. When that work was finished the Society might be reconstituted, and the publication of others commenced.

In answer to a further question from Dr. Basham, the Secretary and Mr. Watts stated that the completion of Gmelin's *Chemistry* and the copious index would probably occupy three more volumes, and the publication extend over three more years. The last part of the work issued in Germany had but just been received, and the translation of it would be immediately proceeded with.

The thanks of the meeting were voted to the President, Council and Officers, also to the Local Secretaries.

NOTICES OF BOOKS, PATENTS, &c.

Thénard. 'Eloge historique, etc. par M. Flourens. Read before the Academy of Sciences, 30 Jan. 1860. (Moniteur, 31 Jan. 1860.)

Conspicuous on the roll of those whose genius and labours have placed them in the front rank of their fellow-men, appears the name of Louis Jacques Thénard. From the most humble origin, he became a peer of France, and died at an advanced age, full of those honours which no monarch can confer, much less take away. Our limited space precludes our presenting more than a condensed review of the interesting panegyric of M. Flourens. Prefacing his subject by a brief retrospect of the more remarkable epochs of chemical philosophy, he introduces to us Thénard at seventeen years of age, just arrived in Paris from his native Champagne, with an income of sixteen sous a day, but with a heart and will of a value beyond all calculation. Two other lads, fired with the ambition of becoming country apothecaries, accompanied him. Thénard as leader of the party soon found a garret they could occupy in common, and by his frankness and address so won the motherly heart of the landlady, that in spite of her misgivings, when contemplating the requirements of three young stomachs, she boldly accepted the youths as boarders. Thénard now proceeded with his main object. Day after day he devoured with ears and eyes the brilliant discourses of Fourcroy, and the more experimental expositions of Vauquelin, but only to make the sad discovery, which, as M. Flourens says, incapables never make, that he knew nothing. His keen perception soon showed him, that to master a non-speculative science it is necessary to learn the craft (*métier*). Now Vauquelin took pupils, but his fee was twenty francs a month. We have seen the depth of Thénard's exchequer, and to meet Vauquelin's terms was impossible. Boldly, however, he seeks the great man, tells him the whole truth, and implores to be taken if only as a servant. Vauquelin refused; but that same impetuous candour which had already done him so great service, again touched the heart of woman, and found in it a sympathising advocate. The intercession of Vauquelin's sisters gained him what he sought, and for three long years he devoted himself to the drudgery of the laboratory, working, observing, and never ceasing to hope

for a brighter lot. A memorable event was at hand. Vauquelin had entrusted to his chief assistant the task of analysing a specimen of beryl. Thénard's assistance was required. The report was that the mineral contained nothing but what was already known. Vauquelin, greatly doubting it, ordered the whole to be done over again. In the mean time Thénard had collected all the materials of the first inquiry, and at the end of a month he presented to his astonished master a new substance. The final analysis was placed in his hands, and the result was a beautiful specimen of *glucina*. The discovery, Vauquelin made known to his class, at the same time loading his young assistant with praise, and propheeying his future eminence.

A professorship in an institution was soon offered to him through Vauquelin's interest, and with a view to overcome his provincial accent and manner, he attended the theatre as often as he could scrape together the necessary thirty sous. For a few days he occupied a position, honourable, but painful from his youth and inexperience, as Vauquelin's substitute, and venturing at his fifth lecture to raise his eyes, the sight of his master and Fourcroy put him to flight. We soon find him installed as a teacher in the Polytechnic School, a post which gave him leisure to produce some original memoirs, the first of which, read before the Academy in 1799, was the precursor of a series extending over more than half a century. We can only indicate as among the labours of his earlier years investigations relating to organic chemistry, the metallic oxides and the ethers, nor should we omit the discovery of artificial ultramarine. Then sprung up imperious demands for material of war, and in the prosecution of military chemistry Thénard and Gay-Lussac became inseparable friends under the roof of Berthollet. But amid the din came the tidings of Davy's great discovery of potassium and sodium, and it is but justice to record, that notwithstanding the war, the great English philosopher was invited over to receive the prize awarded by the Institute. But Napoleon was not well pleased. "Do you mean to endure that victory of the English?" he said impatiently to Berthollet. A huge battery was forthwith constructed and entrusted to Thénard and Gay-Lussac. They soon however, announced that, by availing themselves of the ordinary chemical affinities, they could separate the new metals more easily than by the battery, and they succeeded in isolating a new body, which they called *boron*. Davy elaimed the new substance, which he said he had seen the year before. Thénard and Gay-Lussac would not concede the priority of discovery, and at the same time contended that sodium and potassium were not simple bodies, but combinations of the alkalies with hydrogen — *hydrides* in fact. Davy replied that if they held this theory, they must allow that their *boron* was only a *hydride of boracic acid*. There was no reply to this. A long controversy afterwards followed which, among other things, led Davy to the discovery of the true nature of chlorine.

A constantly increasing reputation was crowned by Thénard's elevation to the chair of Fourcroy. He now married, and then commenced a course of prosperity due alike to his labours, to his marriage, and to his good management, resulting in the accumulation of a large fortune. Precision was one of Thénard's characteristics, and the want of it in his assistants elicited another—an excitable temper. If an experiment failed or was not ready at the moment, the delinquent was overwhelmed with a storm of reproaches, and even, it is said, got his ears boxed occasionally. But his goodnature was always at hand, and he would apologetically observe that Fourcroy had often treated him in like manner, and that it sharpened the wits. We read how his own sharpness availed him in his discovery of the binoxide of hydrogen in 1818, a discovery which attracted many chemists to Paris, and among them Berselius, between whom and Thénard an immediate intimacy sprung up. We are amusingly told how, soon after their interview, when Thénard was progressing brilliantly with his lecture at the Sorbonne, he happened casually to look towards a corner of the theatre. Immediately he began to hesitate, and at last broke down. "Gentlemen," he said in explanation, "there is Berzelius." The solemn Swede was forthwith carried in triumph to a seat near the chair, exclaiming in his progress that it was impossible not to be a good professor with such pupils. We may imagine the gratification of the warm-hearted Thénard. A striking evidence of that generous nature was shown when he was told that Charles X. had created him a baron. "And why not Gay-Lussac too?" he inquired; "he deserves it as well." When again the paintings with which Gros had adorned the dome of the Panthéon were ruined by the damp permeating the stone, Thénard, full of compassion for Gros, devised a plan which was so well received at the Tuileries, that a royal promise was made of which he felt assured he should never avail himself. But the occasion came. A section of a mob flying before the police had contrived to slip into his theatre, which after lecture was discovered surrounded by a guard prepared to arrest all who came out. Thénard's proposal of a sifting process was agreed to with difficulty. Those who had notes were allowed to pass, those who could answer a chemical interrogatory likewise. But fifty, who had no notes and could give no answers, were marched off to prison. The sight was too much for Thénard. He runs to the minister of the interior, to the prefect of police, but without success. Suddenly he remembers the promise of the king, rushes to the Tuileries, after some difficulty obtains an audience, and at midnight is at the prison door with an order for their release. "You can go, Messieurs," he exclaims; but stopping suddenly he adds: "On one condition—you must all study chemistry." We must relate an accident at lecture which threatened serious consequences. He drank what he supposed to be some water. Discovering his mistake, he calmly said, "Gentlemen, I am poisoned. Fetch me some eggs." It was a solution of corrosive sublimate he had swallowed. Inflammation of the stomach supervened, and for many days he lay in great danger, his house the while surrounded by a triple chain of students, who day and night preserved the profoundest tranquillity in the neighbourhood. When he reappeared in his place the universal joy passed all bounds. But the shadows now began to fall fast on his declining years. The death of his mother-in-law was followed by that of his wife and youngest child. A brother, a sister, a nephew were next lost to him, and except for an only son, on whose life he dared hardly depend, the brave old man was left alone in the world. At eighty years of age he followed those whom he had loved so well. But before he died his benevolent heart had originated a noble project, and the widow, the orphan, and the struggling student in generations to come will learn in their hour of need to bless and honour the name of Thénard.

A Composition named Zeiodelite, a kind of Paste which becomes as hard as Stone, is unchangeable by the Air, and being proof against the action of Acids, may replace Lead and other substances for various uses. Joseph Simon, 1859.

Zeiodelite is made by mixing together 19 lbs. of sulphur and 42 lbs of pulverised stone ware and glass. The mixture is exposed to a gentle heat, which melts the sulphur, and then the mass is stirred until it becomes thoroughly homogenous, when it is run into suitable moulds, and allowed to cool. This preparation is proof against acids in general, whatever their degree of concentration, and will last an indefinite time. It melts about 120° Centigrade, and may be re employed without loss of any of its qualities, whenever it is desirable to change the form of an apparatus, by melting at a gentle heat, and operating as with asphalte. At 110° Centigrade it becomes as hard as stone, and therefore preserves its solidity in boiling water. Slabs of zeiodelite may be joined by introducing between them some of the paste heated to 200° Centigrade, which will melt the edges of the slabs, and when the whole becomes cold it will present one

uniform piece. Chambers lined with zeiodelite in place of lead, the inventor says, will enable manufacturers to produce acids free from nitrate and sulphate of lead. The cost will be only one fifth the price of lead. The compound is also said to be superior to hydraulic lime for uniting stone, and resisting the action of water.

CORRESPONDENCE.

The Connection between the Atomic Theory and the Divisibilty of Matter.

To the Editor of the Chemical News.

Sir, — The following considerations may do something towards throwing this question into a more intelligible form. There can be no doubt that, at any rate mechanically, the divisibility of matter has some practical limitation; and that, beyond this, no human agency can carry the subdivision further. I apprehend that no person can consider this, and pronounce himself unsatisfied as to its truth. But when we come to chemical combinations, more especially where their mathematical precision is formally evident, which is the case in crystallised substances, the universality of the former proposition is not so evident. The perfect regularity here witnessed, seems to prove that these substances are composed of infinitely small particles; and the same idea arises from the diffusibility of various salts, and other phenomena.

But here I use a term which I do not pretend to understand, and which I apprehend never has been and never will be understood. The term infinite is one which, it appears to me, the human mind will never be enabled to comprehend. This is not the place for entering into a discussion upon the matter; and I shall only remark that it may be found fairly argued in the pages of Locke. Forming, however, the best idea we can of infinite, and it is but a miserable approximation after all, I would urge whether we can suppose water and other chemical compounds to be the union of atoms, which *per se* are such; and whether a less difficulty applies to the constituents of other bodies.

However unable man may be practically to reduce bodies beyond a certain size, which however may be termed, and is in reality, indefinite, I maintain that the infinite divisibility of matter is, at any rate, as far as theory goes, at once according to human reason. In fact the opposite idea is at once theoretically absurd. But upon meeting the experimental view of the question, a rather unmanageable difficulty rises before us; and we are the worse off from being obliged to grapple with a term which we so meagrely apprehend. However difficult it is to conceive that water is composed of a countless number of infinitely small atoms, it is surely far more difficult to understand how the formation of crystals can result from the union of bodies, which, reason causes us to believe, are similarly constituted. We cannot help reflecting how a finite power, in this case that of chemical affinity, can work upon infinity in number; and the same difficulty awaits us upon the consideration of size. It is true that the space occupied is finite, but this in no way lessens the difficulty, making it in fact more mysterious; because we see that a circumscribed amount of space contains two infinites, those regarding size and number, and that even infinite space could, as regards the atmosphere, we may say does, contain no more. I think a profound consideration of the matter will hereafter convince all philosophers that the finite powers of nature work upon bodies, or collections of forces, taking matter to be nothing more, infinite both in size and number. Priestley, adopting this hypothesis of Boscovich, has (*Disq. on Matter and Spirit*) somewhat elegantly illustrated it. It is evident that any assignable portion of matter, or collection of forces or powers, is capable of decrease: hence any really definable atoms or particles may be divided, which is against the radical idea of such, and consequently destroys them. It should be observed, that infinitely small particles are not assignable, or capable of being numerically defined; while others, if incapable of division practically, can by supposition be divided. But no person will undertake to suppose, much less divide, or in any way represent, the half of an infinitely small atom. In applying these remarks to the atomic theory, I think it only necessary to urge that the atoms there for convenience supposed to exist should be considered numerically undefinable. By considering them infinite I apprehend that a scientific formula would be replaced by a philosophical reality, and that the purpose the former now serves would in every way be supplied by the latter —I am, &c.

J. A. Davies.

To the Editor of the Chemical News.

Sir, — I should feel very much obliged if you would advise me what works are suitable to read up for the second B. Sc. London University examination. Where time is valuable, it is important not to waste it in perusing books not exactly fitted for any particular examination.—I am, &c.

Inops.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Zinc Ore in the form of Oolite.—In a zinc mine near Udias, in the province of Santander, Spain, two cavities were broken open, one of which was found filled with a clear zinc solution, and in the other was a quantity of zinc ore in the form of oolite. It consisted of granules arranged in concentric layers, which on being broken often split into thin plates. The outer layers were opaque and milk white, while the inner were transparent and glossy, so that the granules looked like fishes eyes. It is remarkable that the granules coming from the same vein should not have the same composition; but some were found to consist of a basic hydrated oxide and carbonate of zinc, and others were a hydrated silicate. The carbonate had the specific gravity of 2·042, and the silicate 2·762. Both minerals contained a little nitrogenous organic matter. Both were soluble in acids, the silicate giving gelatinous silica. The carbonate had the following composition:

ZnO	58·93
$ZnO.CO_2$	34·72
$CaO.CO_2$	2·85
$Al_2O_3.Fe_2O_3$	0·80
HO	12·40
Hygroscopic water	3·13
Organic matter	a trace

The formula is:

$$2(ZnO.HO) + ZnO.CO_2.$$

The silicate has the formula:

$$2[ZnO.SiO_3 + 3(ZnO.HO)] + ZnO.CO_2.$$

Its analysis gave:

$ZnO.SiO_3 + \left.\begin{matrix}\\ ZnO.HO\end{matrix}\right\}$	83·93
$ZnO.CO_2$	10·36
$CaO.CO_2 + Al_2O_3 + Fe_2O_3$	0·46
Hygroscopic water	5·16
Organic matter	a trace.[1]

The Atomic Weight of Lithium.—W. Mallet[2] has determined the atomic weight of lithium by means of the decomposition of sulphate of lithia by chloride of barium. He calculates from the amount of chloride of barium required to precipitate the sulphuric acid for lithium as the mean of four experiments Li = 7·005, or 7, considering H = 1, and 87·5, if O = 100.

[1] *Terreil, Comptes-Rendus*, t. xlix. p. 553.
[2] *Silliman's American Journal*, v. xxviii. p. 351.

II. ORGANIC CHEMISTRY.

Compound of Oil of Bitter Almonds and Chloride of Calcium. — If powdered chloride of calcium is added to pure oil of bitter almonds the mixture solidifies with development of heat. If only a small quantity of chloride of calcium is added, crystals are soon deposited, which are speedily decomposed. Two specimens quickly pressed and weighed gave on analysis 19·8 and 23·4 of calcium. These members correspond to 2·5 and 3·3 molecules of chloride of calcium to 1 molecule of bitter almond oil.[3]

Action of Chlorous Acid on Organic Matters. Schiel has observed[4] that ethylic and amylic alcohols when treated with chlorous acid are changed into acetic ether and valero-amylic ether, perfectly free from chlorine:

Acetic ether.

$$2\left.\begin{matrix}C_4H_5\\H\end{matrix}\right\}O_2 + ClO_3 = \left.\begin{matrix}C_4H_3O_2\\C_4H_5\end{matrix}\right\}O_2 + 3HO.Cl.$$

Valero-amylic ether.

$$2\left.\begin{matrix}C_{10}H_{11}\\H\end{matrix}\right\}O_2 + ClO_3 = \left.\begin{matrix}C_{10}H_9O_2\\C_{10}H_{11}\end{matrix}\right\}O_2 + 3HO + HCl.$$

Caprylic alcohol behaves differently.

Urea is slowly decomposed in contact with a solution of chlorous acid, and carbonic acid is disengaged. By evaporation on a water bath a crystalline mass is obtained, which is purified by solution in alcohol and re-crystallisation. The crystals are acid, but they decompose when heated to 165° and give off ammonia. On analysis they were found to have the composition expressed by the formula:

$$C_3H_8N_3ClO_2$$

which would indicate that the new body was a combination of urea and chloride of ammonium:

$$\left.\begin{matrix}C_2O_2\\H_4\end{matrix}\right\}N_2 + NH_4Cl.$$

The reaction may be thus explained:

$$2\left(\left.\begin{matrix}C_2O_2\\H_4\end{matrix}\right\}N_2\right) + ClO_3 = \left(\left.\begin{matrix}C_2O_2\\H_4\end{matrix}\right\}N_2 + NH_4Cl\right) + C_2O_4 + NO.$$

The behaviour of the new body with nitric acid does not support the idea of its being a compound of urea and sal ammoniac. Its alcoholic solution gives with nitric acid a precipitate of scaly crystals, but slightly soluble in cold alcohol, which after washing with spirit and drying have a beautiful mother-of-pearl lustre, and on analysis are found to contain chlorine. The same body cannot be obtained by crystallising together like proportions of urea and sal ammoniac.

With uric acid chlorous acid gas produces a new acid, which the author calls *chloraluric acid*. An aqueous solution of chlorous acid is used, which is added by degrees to the uric acid until nearly all the latter is dissolved, and the solution has acquired a greenish colour; it is then poured off the undissolved uric acid and evaporated on a water bath. The white mass left is then dissolved in hot alcohol of 90 per cent., and on cooling the chloraluric acid separates in nacreous scales. It is soluble in water, and the solution has a strong acid reaction. Combined with soda or potash it gives a crystalline precipitate with the nitrates of baryta and lead, and a curdy precipitate with nitrate of silver. The silver and lead precipitates are insoluble in water. On analysis the acid was found to have the composition $C_{14}H_{11}N_6ClO_{11}$. When an excess of chlorous acid is used, two other bodies are formed, one an amorphous yellow, and the other a reddish brown crystalline substance; but these the author has not well examined.

Action of Organic Chlorides on Glycol, &c. — M. Lourenço says that the chlorides of acetyle and butyryle act on glycol with great energy at the ordinary temperature with the disengagement of hydrochloric acid and the volatilisation of part of the chloride. If the mixture be made in a cooled tube it may be sealed before the action begins. The products obtained by making use of the chloride of acetyle and heating for some hours in a water bath are water and a limpid chloride heavier than water, which possesses all the properties of chloracetine. If the mixture is made at the ordinary temperature and the hydrochloric acid is allowed to escape before sealing the tube, the monoacetic glycol is obtained besides.[5]

III. TECHNICAL CHEMISTRY.

Behaviour of Coal Gas with Fatty Oils. — Coal gas is a mixture of elayle with various hydrocarbons, some of which the author supposed might be withdrawn by means of fatty oils, which experiments proved to be the fact. He passed dry coal gas through a potash apparatus filled first with almond oil and then with lamp oil. The gas was allowed to pass until there was no further increase of weight. The weight of the almond oil was found to be increased by 9·3 per cent., and lamp oil as much as 20·5 per cent. The illuminating power of the coal gas did not appear to be lessened, while that of the lamp oil was considerably increased. Wax, tallow and stearine exposed for some time to the influence of gas seemed to absorb a large quantity of it and to become soft. The above experiment might be turned to account in improving the illuminating quality of the fatty oils.[6]

Yellow Dye from Catechu. — If powdered catechu is treated with nitric acid at a temperature of 113° F. until nitrous acid is no longer evolved, a yellow substance is obtained with exactly the same properties as picric acid, and moreover is more soluble in cold water. Silk and wool may be very easily dyed with a cold solution. Silk is instantly coloured, but wool requires a longer time. To produce the yellow powder the best brown catechu must be employed. It is unimportant whether the nitric acid is poured on the catechu or the catechu is stirred into the the nitric acid.[7]

Analysis of Porcelains. — Joseph Muller[8] publishes analyses of several celebrated porcelains. The various kinds found in commerce show the greatest differences in their physical properties, on which account one or another seems especially adapted for chemical and pharmaceutical purposes and is preferred to all the others. With a view to discover how far these properties depend on the composition, the author analysed several porcelains. The results were as follows:

	I. Meissen porcelain.	II. Elgersburg.	III. Bohemian.
Silica	60·033	72·77	74·798
Alumina	35·435	24·53	21·303
Potash	2·264	0·94	2·484
Soda	1·547	1·61	0·584
Lime	0·577	—	0·639
Magnesia	trace	trace	trace
Peroxide of iron	trace	trace	—
Sulphuric acid	—	0·06	0·087
	99·856	99·91	99·895

For comparison the author adds the analysis of Nymphenburg porcelain by Vielguth, and of Berlin by Wilson:

	I. Nymphenburg.	II. Berlin.
Silica	72·80	71·340
Alumina	18·40	23·763
Peroxide of iron	2·50	1·743
Lime	3·30	0·568
Magnesia	0·30	0·192
Soda	1·84	—
Potash	0·65	2·001
	99·79	99·607

[3] *Ekman, Annal der Chemie und Pharm.* Bd. cxii. s. 175.
[4] *Annalen der Chemie und Pharmacie*, Bd. cxxii. s. 73.
[5] *Science pour Tous*, 9 Fèv. 1860.
[6] *A. Vogel, Junr. Buchners' Neues Repertorium*, Bd. viii. heft. 6.
[7] *Deutsche Musterzeitung*, No. 10, 1859.
[8] *Wittstein's Vierteljahrsschrift*, Bd. viii. heft 3.

SCIENTIFIC NOTES AND QUERIES.

Lead in Filtering Paper. — Sir,—Whether it be true or not that lead is occasionally to be found in filtering paper, as stated in your "Notices from Foreign Sources," is not of much importance. The careful toxicologist would no doubt well wash his paper with dilute nitric acid before filtering a suspected liquid. At all events now that it has been shown that lead may be present, it would be well to do so. The discovery of lead, however, suggests the possibility of more important contamination, which will no doubt receive the serious attention of analysts.—*G. M.*

MISCELLANEOUS.

Amount of Tannin in some Materials. — The following table we have taken from the *Irish Agricultural Review*. The names Mulligan and Dowling are those of two chemical students belonging to the Museum of Irish Industry in Dublin. Their analysis is quite recent, and will be very interesting and useful to our tanners:—

	Per cent.	*Authority.*
Oak bark formation, 100 years old	8·45	G. Muller.
" young	13·87	"
" British, 50 years old	8·90	Mulligan and Dowling.
" " age about 50 years	9·76	" "
" " " 70 years	6·12	" "
" Southampton, age about 50 years	8·80	" "
" coppice, picked sample	12·35	" "
" Irish, picked sample, 45 years	9·50	" "
Oak, old, white inner bark	21·00	Cadet de Gassincourt.
" " "	14·20	Sir H. Davy.
Oak, young	15·20	"
" coloured or middle bark	4·00	"
" entire bark	6·00	Sir H. Davy and Gelger.
" spring cut bark	22·00	Sir H. Davy.
Oak bark, Belgian	8·33	Mulligan and Dowling.
" " heavy	10·74	" "
" " light	8·52	" "
" Eschugrh	19·35	G. Muller.
Mimosa or Wattell bark	17·97	Mulligan and Dowling.
" "	31·16	G. Muller.
Willow bark	3·95	Mulligan and Dowling.
" Leicester, white inner bark	16·00	Sir H. Davy.
" " col'd. or middle bark	3·10	"
" " entire bark	0·80	"
" weeping	16·40	Cadet de Gassincourt.
Larch bark	3·51	Mulligan and Dowling.
"	1·00	Sir H. Davy.
Cork tree bark	12·16	Mulligan and Dowling.
Hemlock bark	13·98	" "
Divi-Divi	29·80	" "
"	49·25	G. Muller.
Valonia Smyrna	34·78	Mulligan and Dowling.
Myrabolams	20·91	" "
Shumac	19·35	G. Muller.
" Palermo	24·37	Mulligan and Dowling.
" "	16·20	Sir H. Davy.
" Malaga	10·40	Frank.
" Carolina	5·00	Cadet de Gassincourt.
" Virginian	10·00	"
Catechu, Bombay, light colour	26·32	Mulligan and Dowling.
" " "	55·00	Sir H. Davy.
" Pegu, dark brown colour	46·88	Mulligan and Dowling.
" Bengal	44·00	Sir H. Davy.

Recipes for making Coloured Inks.—The following are a few recipes for making coloured inks, which may be used by fancy writers; and as they are not to be found on sale, they may be very useful to some of our readers:—

Gold Ink. — Mosaic gold 2 parts, gum arabic 1 part, are rubbed up with water until reduced to a proper condition.

Silver Ink.—Triturate in a mortar equal parts of silver foil and sulphate of potassa, until reduced to a fine powder, then wash out the salt, and mix the residue with a mucilage of equal parts of gum arabic and water.

Brown Ink.—Digest powdered catechu 4 parts, with water 60 parts, for some hours; filter and add sufficient of a solution of bichromate of potassa, 1 part in 16 of water.

Yellow Ink.—Macerate gamboge 1 part (or 1½), alum ½ part, gum arabic 1 part, in acetic acid 1 part, and water 24 parts.

Blue Ink.—Triturate best Prussian blue 6 parts, with a solution of 1 part of oxalic acid in 6 of water, and towards the end of a quarter of an hour or so add gradually gum arabic 18 parts, and water 280. Pour off clear

Red Inks. — 1. Pernambuco wood 4 parts, alum and cream of tartar, of each 1 part with 30 of water; boil down to 16 parts, let stand, pour off, filter and dissolve in the liquid, gum arabic 1½ parts, white sugar 1 part.

2. Digest powdered cochineal 8 parts, and carbonate of potash 16 parts in 144 of water, for 24 hours. Then boil up with powdered alum 4 parts, and add 24 of cream of tartar, with 3 parts of tartaric acid, and when effervescence has ceased, another part of the acid, or enough to produce the colour. Let cool, filter, and boil the residue on the filter with 12 parts of water: filter again, mix the liquids and dissolve in them 24 parts of gum arabic, and lastly ½ part of oil of cloves. No iron vessels must be used in this process.

3. Digest powdered cochineal 16 parts, oxalic acid 2 parts, dilute acetic acid 80 parts, distilled water 40 part for 36 hours. Then add powdered alum 1 part, gum arabic 1 to 10, shake up, let stand for 12 hours and strain.

4. Dissolve 1 part of carmine in 8 to 10 parts of aqua ammonia, and add mucilage of gum arabic sufficient to reduce it properly.

Violet Ink. — 8 parts of logwood and 64 parts of water; boil down to one half, then strain and add 1 part of chloride of tin.

Green Inks. — 1. Digest 1 part of gamboge with from 7 to 10 parts of the blue ink.

2. To powdered bichromate of potassa 8 parts, contained in a porcelain dish, add oil of vitriol 8 parts, previously diluted with 64 of water; then heat, and while evaporating add gradually 24 parts of alcohol, and reduce to 56 parts, which filter, and in the clear liquid dissolve 8 parts of gum arabic.

Crimson Ink.—A beautiful crimson ink is made by mixing red ink No. 1 with the violet ink: about equal parts will answer.

The parts given are those of weight, not measure. The mucilage of gum arabic prevents the fine particles of colour falling to the bottom in the form of a sediment. Sugar gives to inks a glossy appearance, but very little of it should be used, as it is liable to make the ink sticky.

Duty on Chloroform. — Chloroform has been struck out of the list of articles to be admitted free of duty.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

W. T. L. — The methods of making putty powder will be found in *Cooley's Cyclopædia of Practical Receipts.*

Excelsior. — *Hassall's Adulterations of Food and Drink*, 12*s*. *Electrotype Manipulations*, parts I. and II. or *Manual of Electro-Metallurgy*, by Napier, 3*s*. 6*d*.

A Constant Subscriber. — The decay of various parts of a plant is at times accompanied by a peculiar decomposition resulting in the development of a substance which, like phosphorus, burns at the ordinary temperature producing light. It must be considered as a peculiar and easily combustible compound of carbon, hydrogen, and oxygen. See Gmelin's *Chemistry*, vol. i. p. 191. A scale of graduated shades is painted to serve as a standard of comparison. Ozone is supposed to be oxygen in a peculiar state. See Chemical News, No. 10, p. 109.

M. A. B.—We are not at liberty to divulge the name or address of the writer of the letter alluded to. The author is *not* the gentleman whom you have mentioned. We will forward any communication which you may have to make to the writer.

W. H. (Tillydesk) —By "next week" we intended to intimate that a reply would be given on the following week, but unfortunately the matter escaped our notice. The opinion as to the value of the process was quoted from Dr. Noad, who is certainly a good authority on such matters.

S. E. (Birmingham)—It could only be made into bricks by powdering it finely, moistening with water, and pressing into moulds. On the other point our correspondent will receive a private communication.

M. P.—The title of the book, we think, is *The Art of making Perfumes*, by Septimus Piesse. There is an American work on the same subject by Morfitt, but it is larger and more expensive.

Anode.—Electricity has never been made use of as a motive power on a large scale. See Liebig's *Letters* for Comparative Cost of Steam and Electricity.

J. M. F. (Chelmsford) — The last edition of Fowne's *Manual of Chemistry*.

J. Gordon—Tyro—R. A. C.—W. J. J.—received — answers next week.

Erratum.—Page 153, line 20, for 14 read 1·4.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business* communications to the Publisher, at the Office; 12 and 13 Red Lion Court, Fleet Street, London E. C.

THE CHEMICAL NEWS.

VOL. I. No. 15. — March 17, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Numerical Relations existing between the Equivalent Numbers of Elementary Bodies, by CAREY LEA.[1]

IT is evident that the number 44—45 plays an important part in the science of Stoichiometry. If we form a descending arithmetical series beginning with antimony =120·3 and diminishing by common difference of 45 (45·3 in one instance, and 44 in several) we shall find that such a series does not cease with the third term P=31; but that the difference of 31 and 45 will give a fourth—14 the exact equivalent of nitrogen with the negative sign. The fifth will be —59 the equivalent of tin with the negative sign. The sixth —104, or very nearly the equivalent of lead. The seventh —149, very nearly the double of the equivalent of arsenic, a previous term in the same series. These results are exhibited in the following table:

Differences.		Calculated Equivalents.		Received Equivalents.
45	. .	120	. .	Sb = 120·3.
	. .	75	. .	As = 75.
44	. .	31	. .	P = 31.
45	. .	−14	. .	N = 14.
45	. .	−59	. .	Sn = 59.
45	. .	−104	. .	Pb = 103·5.
45	. .	−149	. .	2As = 150.

The relations can be carried still further — the ninth term giving —239 or 2Sb=240·6; and the thirteenth, —416 or exactly 2Bi=416.

If we examine the position occupied by antimony, arsenic, phosphorus and nitrogen in the electro-chemical scale of Berzelius, we shall find that in proportion as their equivalent numbers diminish, their properties become more and more electro-negative; a corresponding change is also visible in the organic radicals which these elements are capable of forming by their union with carbon and hydrogen.

Standing between nitrogen and arsenic, phosphorus is in every way more closely allied to the latter of these substances, not only by the analogies of its organic radicals, but also by the polybasic nature of phosphoric acid. Although tin and lead represent further numbers of the same series in reference to their equivalent numbers it is evident that the increase of electro-negative relations does not extend to them. Moreover bismuth, antimony, arsenic, phosphorus and nitrogen at their maximum of oxidation combine with five equivalents of oxygen and chlorine, whereas tin unites with but two of each, and lead at most with two of oxygen and one of chlorine.

Again if we begin with phosphorus and form an ascending series with a common difference of 44 or 45, we have P=31+44=75 (As). 75+45=120 (Sb=120·3). 120+44=164 (absent). 164+44=208 (Bi.) These four elements exhibit strong analogies, and are all isomorphous with each other.

If taking mercury as the starting point we subtract the number 44 from each term to find the following one, we shall obtain the (series) Hg100—44=56(Cd). 56—44=12(Mg). 44—12=—32(Zn=32·6). The salts of the protoxides of the three last of these metals are isomorphous. It may seem forced to place mercury in the same group, but its analogies with zinc are perhaps as strong as those which it exhibits with silver, next to which it has usually been classed.

It is not a little curious that the numerically negative numbers of this series lead into the positive of the foregoing: if we continue the subtraction of 44 we find for the fifth number 76, or nearly the equivalent of arsenic, for the sixth 120, or nearly that of antimony, for the seventh 164, corresponding with a possible undiscovered metal, and for the eighth 208, or exactly the equivalent of bismuth. The two series thus naturally lead to each other.

The magnesia group includes a well-marked natural family of metals, whose oxides, having the constitution Ro, are related with each other by isomorphism. The equivalents of these metals, according to the most recent determinations, are as follows: —

Mg 12	Ni 29·6	Cd 56.
Mn 27·5	U 60	Cu 31·7.
Fe 28	Cr 26·7	Pb 103·5.
Co 29·5	Zn 32·6.	

The equivalents of the above metals are related in the following manner by the number 44. Cu and Mg, Zn and Mg, the sum of each pair is 44 nearly. With Cd and Mg, Pb and U, the difference of each pair is 44 nearly. With W and Mg, W and Fe, U and Co, U and Ni, U and Cr, Cd and Zn, the mean term is 44 or nearly. With Pb and Mn, Pb and Fe, Pb and Ni, Pb and Co, Pb and Cr, the sum of each pair is three times 44, or nearly. The equivalent of Mg added to that of Zn gives 44 nearly, subtracted from that of Cd 44 exactly.

The following metals may be classed together as tending to form acids:

Sn 59	Ta 68·6	Va 68	Te 64.
Ti 25	W 92·	Mo 48	Nb 48·82.

Relations depending upon the number 44 can be shown to exist between these equivalents, and these analogies, though many are very complex, approach exceedingly near to absolute exactness. We give one or two illustrations. If we subtract Ti 25 from Ta 68·6 or V 68·8 the remainders are 43·6 and 43·8 very nearly 44.

If we add Sn 59, Ta 68·6, W 92, V 68·8, and Te 64, the result is 352·4, or 8×44=352.

If we add Ta 68·6, Mo 48, 2 Sn 118, V 68·8, Nb 48·82, we have 352·22, 8×44=352.

If commencing with gold Au=197, we form a diminishing series with a common difference of 44·5, we shall find for its terms, 197 Au, 152·5 absent, 108 Ag, 63·5 or Cu=63·4. The equivalent of Cu is here taken at double that usually employed, and it is doubtful if this be not the true equivalent. It can be shown that these metals as well as many others here grouped by relations depending upon a number approximating to 44·3 are also united by analysis of atomic volume.

The same relation may be extended to the platinum

[1] Abridged from *Silliman's Journal*, Jan. 1860.

group, which naturally subdivides itself into two families. The members of each family have nearly the same equivalents, and the difference between the equivalents of the two families approaches to 45.

Rhodium	52·2	Platinum	98·7
Ruthenium	52·2	Iridium	99·
Palladium	53·3	Osmium	99·6

The elements carbon, boron, and silicon, are united by the number 44 in following manner. If we take the equivalent of carbon as 12, and that of boron as 11, then the sum of the equivalents of these three substances amounts 44 exactly.

Carbon (C)	12
Boron	11
Silicon	21
	44

The equivalent of nitrogen added to 3 times 45, and divided by 8, gives nearly the equivalent of fluorine. In the same way, 14 added to 6 times 45 and divided by 8 gives the equivalent of chlorine. Similarly

$\frac{14+14\times45}{8}=80\cdot5\,Br=80$ | $\frac{2\times14+22\times45}{8}=127\cdot25\,I=127.$

Several elements taken in pairs have equivalents which differ from each other by a number approximating to 45. For instance:

$$Na\,23+45\cdot6=Ba\,68\cdot6.$$
$$Cl\,35+45\cdot5=Br\,80\ \&c.$$

In this way, by sometimes adding, sometimes subtracting, sometimes multiplying, sometimes dividing, and sometimes by performing all these operations together, the author finds that some relation to the number 44–45 extends to no less than 48 of the elementary bodies; to all, indeed, except those as yet imperfectly understood, most of which may yet range themselves under the same laws, and except the group oxygen, sulphur, selenium, and tellurium, substances which stand above and unmistakeably apart from the other elements.

On the Action of Chloride of Ethyl upon Ammonia[1], *by* C. E. Groves.

The action of chloride of ethyl upon ammonia not having previously been examined, the author effected the reaction by heating to 100° C. in sealed tubes a mixture of one measure of chloride of ethyl, with three measures of alcoholic ammonia. A crystalline deposit of sal-ammoniac took place, which was washed with alcohol. The washings were added to the liquid product, which was evaporated to dryness. This residue was dissolved in water, treated with oxide of silver, and the whole submitted to distillation. By this means, a small quantity of hydrated oxide of tetrethylium was left unvolatilised. This was converted into its platinum salt, and analysed. The principal constituent of the distillate was ethylamine; but by fractional precipitations with bichloride of platinum, and frequent crystallisations the presence of diethylamine was also established. It is observable that chloride, bromide, and iodide of ethyl differ somewhat in their reactions upon ammonia. The chloride produces principally ethylamine, with small quantities of di-ethylamine and hydrate of tetrethylium. The bromide produces principally ethylamine, with very appreciable quantities of of di- and tri-ethylamine; while the iodide produces the three volatile bases in about equal proportions, with an appreciable quantity of the tetrethylium compound.

[1] Abstract of paper read at the last meeting of the Chemical Society.

PHARMACY, TOXICOLOGY, &c.

On Syrup of Superphosphate of Iron and other Phosphates used in Medicine, by Samuel Gale, *F.C.S.*

A syrup under this name was introduced to the notice of the Pharmaceutical Society as far back as 1851, by Mr. Greenish, who directs it to be made by adding as much phosphate of iron to a solution of metaphosphoric acid, as the latter in a boiling state will take up, and allowing it to cool: of this compound two scruples are added to an ounce of simple syrup. Now this compound, which has been called biphosphate of iron, is very indefinite, therefore the syrup prepared from it would be liable to the same fault. Another objection is that you have an opaque syrup with a precipitate forming after a short time, making it necessary to label the bottle "to be shaken."

In carrying out these experiments I have tried to gain three points: first, to obtain a syrup that should be definite in strength; secondly, permanently bright; thirdly, easily made. The following is the plan I adopt. Take

Protosulphate of iron		222 grs.
Phosphate of soda	q.s. or	240 „
Water		q.s.
Dilute phosphoric acid		5 oz.
Sugar	(troy)	8 „

Dissolve the sulphate of iron and the phosphate of soda separately, each in 4 oz. of water, mix the solutions and throw the pasty mass formed on a calico filter and wash well with water; then squeeze the precipitate as dry as possible, and add it to the dilute phosphoric acid. As soon as dissolved, filter the solution, which will now be found to measure about 6 oz. In this dissolve the sugar without heat, so that the product shall be exactly 12 oz. Each dram of the resulting product then contains 1 grain of $3(FeO)PO_5$, or rather more than 1¼ grain of $3(FeO)\,PO_5+8HO$ (the form which Gmelin gives for blue phosphate of iron), with 25 minims of dilute phosphoric acid. This is about equal to 5 grains of the so-called biphosphate of iron.

Syrup of Phosphate of Iron and Manganese.—This is made in a similar manner to the foregoing. Take

Protosulphate of iron		124 grs.
Sulphate of manganese (dry)		46 „
Phosphate of soda	q.s. or	240 „
Water		q.s.
Dilute phosphoric acid		5 oz.
Sugar	(troy)	8 „

Dissolve the sulphates in 4 oz. and the phosphate of soda in a similar quantity of water, mix the solutions, wash the precipitate on a calico filter and press as before. Add the precipitate to the dilute phosphoric acid, filter and dissolve the sugar without heat. The product should measure 12 oz., when each dram will contain ¾ grain of phosphate of iron, $3(FeO)\,Po_5+8\,HO$, and ½ grain phosphate of manganese, $3(MnO)\,Po_5+7HO$, with 25 minims of dilute phosphoric acid.

Syrup of Phosphate of Iron, Manganese, and Nickel, may be made in the same manner by taking:

Protosulphate of iron		124 grs.
Sulphate of manganese (dry)		46 „
Sulphate nickel		56 „
Phosphate of soda	q.s. or	240 „
Dilute phosphoric acid		5 oz.
Sugar	(troy)	8 „

Dissolve the sulphates in 4 oz. and the phosphate soda in a similar quantity of water, mix the solutions, throw on a calico filter, wash and proceed as before, making the product measure 12 oz. Each dram then contains ¾ grain phosphate iron, ½ grain phosphate manganese, and ½ grain phosphate nickel, with 25 minims of dilute phosphoric acid.

Syrup of Phosphate of Iron and Lime is at the present time frequently ordered, and the plan I have adopted in making it has been to precipitate the phosphate of iron as

in the previous syrups. Then I take a given quantity of phosphate of lime and dissolve in hydrochloric acid, and reprecipitate it with ammonia, so as to obtain it in a more soluble state than as dry phosphate. Take

Sulphate of iron	124 grs.
Phosphate of soda q.s. or	142 „

Dissolve separately, precipitate, and wash as before.

Dissolve 48 grs. phosphate of lime in a sufficient quantity of hydrochloric acid, diluted with twice its volume of water, then add ammonia: throw the precipitate on a filter and wash; dissolve the above precipitates in 5 oz. dilute phosphoric acid, and add 8oz. sugar to the clear solution, when each dram will contain ¾ grain phosphate iron and ½ grain phosphate of lime with 25 minims of dilute phosphoric acid.

Syrup of Phosphate of Iron:

Sulphate of iron	124 grs.
Phosphate of soda q.s. or	142 „

Dissolve separately, precipitate and wash; add this to 5 oz. dilute phosphoric acid, with 48grs. phosphate of soda, and in the clear solution dissolve 8oz. sugar.

Syrup of Superphosphate of Zinc:

Sulphate of zinc	429 grs.
Phosphate of soda	480 „
Dilute phosphoric acid	5 oz.
Sugar (troy)	8 „

Dissolve the sulphate of zinc and phosphate of soda separately and mix the solutions, collect and wash the precipitate; add this to the dilute phosphoric acid, then dissolve the sugar; let the product measure 12 oz., when each dram will contain 2 grs. phosphate of zinc and 25 minims dilute phosphoric acid.

There is one other preparation of the phosphates, viz. the "Syrup of Pyrophosphate of Iron." In the *Pharmaceutical Journal*, vol. xii. 498, there is a process by Soubeiran for the preparation of this syrup, by precipitating the persulphate of iron with excess of pyrophosphate of soda, the precipitate being soluble in excess of the precipitant and dissolving sugar in the solution without heat. But recently M. Robiquet has introduced a more elegant syrup, which is made by first forming what he calls a "Citro-ammoniacal Pyrophosphate of Iron," known in this country as pyrophosphate of iron. His form is the following:

Sulphate of peroxide of iron	50 parts
Pyrophosphate of soda	84 „
Citric acid	26 „
Ammonia, to neutralise the citric acid	q.s.

Dissolve the sulphate of iron and pyrophosphate of soda separately without heat, and mix the solutions: wash the precipitate and dissolve it in the citrate of ammonia: then evaporate at a low temperature and scale. This is a very elegant preparation. The syrup may be formed by adding 3 grains of the above salt to each dram of simple syrup, or it may be flavoured with orange flowers.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, 9 March 1860.

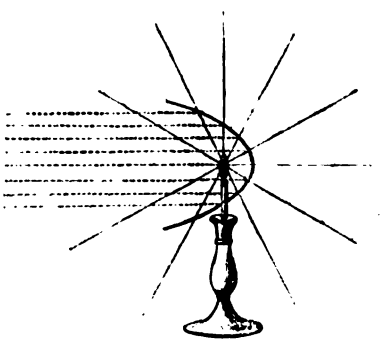
On the Illumination of Lighthouses — The Electric Light, by M. Faraday, *D.C.L., F.R.S., Fullerian Professor of Chemistry, R.I., Foreign Associate of the Academy of Sciences, Paris, &c.*

There is no part of my life which more than my connexion with the Trinity House gives me delight. The occupation of nations joined together to guide the mariner over the sea, to all a point of great interest, is infinitely more so to those who are concerned in the operations which they carry into effect, and it certainly has astonished me since I have been connected with the Trinity House to see how beautifully and how wonderfully shines forth amongst nations at large the desire to do good; and you will not regret having come here to-night, if you follow me in the various attempts which have been made to carry out the great object of guiding in safety all people across the dark and dreary waste of waters. It is wonderful to think how eagerly efforts at improvement are made by the various public bodies — the Trinity House in this country, and commissions in France and other nations; and whilst the improvements progress we come to the knowledge of such curious difficulties and such odd modes of getting over those difficulties as are not easy to be conceived. I must ask you this evening to follow me from the simplest possible method of giving a sign by means of a light to persons at a distance, to the modes at which we have arrived in the present day; and to consider the difficulties which arise when carrying out these improvements to a practical result, and the extraordinary care which those who have to judge on these points must take in order to guard against the too hasty adoption of some fancied improvement, thus, as has happened in some few cases, doing harm instead of good.

If I try to make you understand these things partly by old models, and partly by those which we have here, it is only that I may the better be enabled to illustrate that which I look forward to as the higher mode of lighting, by means of the electric lamp and the lime light.

There is nothing more simple than a candle being set down in a cottage window to guide a husband to his home, but when we want to make a similar guide on a large scale, not merely over a river or over a moor, but over large expanses of sea, how can we then make the signal using only a candle? I have shown in this diagram (*fig.* 1.) what we may

Fig. 1.

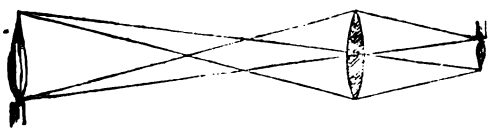


imagine to be the rays of a candle or any other source of light emanating from the centre of a sphere in all directions round to infinite distances. After this simple kind of light had been used for some time, it being found to be liable to be obscured by fogs, or distance, or other circumstance, there arose the attempt to make larger lights by means of fires; and after that there was introduced a very important refinement in the mode of dealing with the light, namely the principle of reflection; — for understand this (which is not known by all, and not known by many who should know it), that when we take a source of light, a single candle, for instance, giving off any quantity of light, we can by no means increase that light: we can make arrangements around and about the light, as you see here, but we can by no means *increase the quantity* of light. The utmost I can do is to *direct* the light which the lamp gives me by taking a certain portion of the rays going off on one side and reflecting them on to the course of the rays which issue in the opposite direction. First of all, let us consider how we may gather in the rays of light which pass off from this candle. You will easily see that if I could take the half rays on the one side and could send them by any contrivance over to the other side, I should gain an advantage in light on the side to which

I directed them. This is effected in a beautiful manner, by the parabolic mirror, by means of which I gather all that portion of the rays which are included in it; upwards, downwards, sideways, anywhere within its sphere of action; they are all picked up and sent forward. You thus see what a beautiful and important invention is that of the parabolic reflector for throwing forward the rays of light.

Before I go further into the subject of reflection let me point out a further mode of dealing with the direction of the light. For instance, here is a candle, and I can employ the principle of *refraction* to bend and direct the rays of light, and if I want to increase the light in any one direction I must either take a reflector or use the principle of refraction. I will place this lens (*fig.* 2.) in front of the candle and you

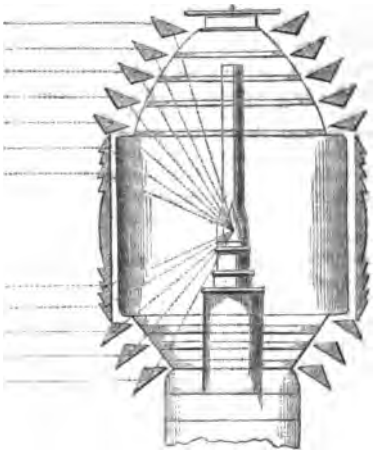
Fig. 2.



will easily see that by its means I can throw on to that sheet of paper a great light, that is to say, that instead of the light being thrown all about, it is *refracted* and concentrated on to that paper; so here I have another means of bending the light and sending it in one direction; and you see above a still better arrangement for the same purpose,—one which comes up to the maximum, I may say, of the ability of directing light by this means. You are aware that without that arrangement of glass the light would be dispersed in all directions, but the lens being there, all the light which passes through it is thrown into parallel beams and cast horizontally along. There is consequently no loss of light, the beam goes forward of the same dimensions, and will consequently continue to go forward for 5 or 10 miles, or so long as the imperfection of the atmosphere does not absorb it; and see! What a glorious power that is, to be able to convert what was just now darkness on that paper into brilliant light.

Whenever we have refraction of this sort we are liable to an evil consequent upon the necessary imperfections in the form of the lens; and Dr. Tyndall will take this lens, and will show you even in this small and perfect apparatus what is the evil of spherical aberration with which we have to fight. This can be illustrated by means of the electric lamp; if you look at the screen, you will see produced, by means of this lens, a figure of the coal points. This image is produced by the rays which pass through the *middle* of the lens, a piece of card with a hole in the centre being placed in front; but if, keeping the rest of the apparatus in the same position, I change this card for another piece which will only allow the rays to pass through the *edge* of the lens, you observe how inferior the image will be. In order to get it distinct I have to bring the screen much nearer the lamp; and so if I take the card away altogether, and allow the light to pass through all parts of the lens, we cannot get a perfect image, because the different parts of the lens are not able to act together. This spherical aberration is, therefore, what we try to avoid by building up compound lenses in the manner here shown. (*fig.* 4.) Look at this beautiful apparatus, is it not a most charming piece of workmanship? Buffon first and Fresnel afterwards, built up these kinds of lenses, ring within ring, each at its proper adjustment, to compensate for the effects of spherical aberration; the ring round that centre lens is ground so as to obviate what would otherwise give rise to spherical aberration, and the next ring being corrected in the same manner, you will perceive, if you look at the disc of light thrown by the apparatus upstairs, that there is nothing like the amount of aberration that there would have been if it had been one great bulls-eye. Here is one of Fresnel's lamps of the fourth order so constructed (*fig.* 3.): observe the fine effect obtained by these different lenses as you see them revolve before you, and understand that all this upper part is made to form part of the lens, each prism throwing its rays to increase the effect, and, although you may think it is imperfect because if you

Fig. 3.



happen to sit below or above the horizontal line, you perceive but little if any of the light, yet you must bear in mind that we want the rays to go in a straight line to the horizon. So that all that building up of rings of glass is for the purpose of producing one fine and glorious lens of a large size, to send the rays all in one direction. Here is another apparatus used to pull the rays down to a horizontal sheet of light, so that the mariner may see it as a constant and uniform fixed light; the former lamp is a revolving one, and the light is seen only at certain times as the lenses move round, and these are the points which make them valuable in their application.

There are various orders and sizes of lights in lighthouses to shine for twenty or thirty miles over the sea, and to give indications according to the purposes for which they are required; but suppose we want more effect than is produced by these means, how are we to get more light? Here comes the difficulty. We cannot get more light, because we are limited by the condition of the burner. In any of these cases, if the spreading of the ray, or *divergence* as it is called, is not restrained, it soon fails from weakness, and if it does not diverge at all, it makes the light so small, that perhaps only one in a hundred can see it at the same time. The North Foreland lighthouse is, I think, 3 or 400 feet above the level of the sea, and therefore it is necessary to have a certain divergence of the beam of light in order that it may shine along the sea to the horizon. I have drawn here two wedges, one has an angle of 15°, and shows you the manner in which the light opens out from this reflector seen at the distance of half a mile or more, the other wedge has an angle of 6°, which is the beautiful angle of Fresnel. When the angle is less than 6°, the mariner is not quite sure that he will see the light—he may be beneath or above it; and in practice it is found that we cannot have a larger angle than 15°, or a less one than 6°. In order therefore to get more light, we must have more combustion, more cotton, more oil; but already there are in that lamp four wicks put in concentric rings, one within the other, and we cannot increase them much more, owing to the divergence which would be caused by an increase in the size of the light—the more the divergence, the more the light is diffused and lost. We are therefore restrained by the condition of the light and the apparatus to a certain sized lamp. At Teignmouth, some of the revolving lights have ten lamps and reflectors, all throwing their light forward at once. But even with ten lamps and reflectors we do not get sufficient light, and we want therefore a means of getting a light more intense than a candle in the space of a candle—not merely an accumulation of candle upon candle, but a

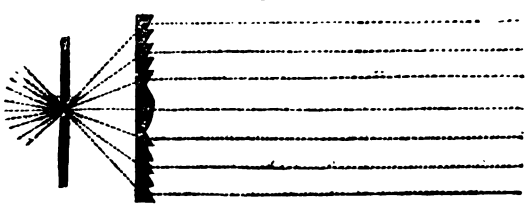
concentration into the space of a candle, of a greater amount of light, and it is here that the electric light comes to be of so much value.

Let me now show you what are the properties of that light which make it useful for lighthouse illumination, and which has been brought to a practical condition by the energy and constancy of Professor Holmes. I will first of all show you the image of the charcoal points on the screen, and draw your attention to the spot where the light is produced. There are the coal points. The two carbons are brought within a certain distance; the electricity is being urged across by the voltaic battery, and the coal points are brought into an intense state of ignition. You will observe that the light is essentially given by the carbons; you see that one is much more luminous than the other, and that is the end which principally forms the spark, the other does not shine so much, and there is a space between the two which, although not very luminous, is most important to the production of the light. Dr. Tyndall will help me in showing you that a blast of wind will blow out that light; the electric light can in fact be blown out easier than a candle. We have the power of getting our light where we please; if I cause the electricity to pass between carbon and mercury I get a most intense and beautiful light most of it being given off from the portion of the mercury between the liquid and the solid pole. I can show you that the light is sometimes produced by the vapour betweent he two poles, better if I take silver than when I use mercury. Here is the carbon pole, there is the silver, and there is the beautiful green light which comes from the intervening portions. Now that light is more easily blown out than the common lamp, the slightest puff of wind being sufficient to extinguish it, as you will see if Dr. Tyndall breathes upon it.

You see, therefore, how we are able, by using this electric spark, to get, first of all, the light into a very small space. That oil lamp has a burner $3\frac{3}{4}$ inches in diameter; compare the size of the flame with the space occupied by this electric light. Next compare the intensity of this light with any other; if I take this candle and place it by the side, I actually seem to put out the candle. We are thus able to get a light which, while it surpasses all others in brilliancy, is at the same time not too large, for I might put this light into an apparatus not larger than a hat, and yet I could count upon the rays being useful. Moreover, when such large burners are used in a lantern, we have to consider whether the bars of the window do not interfere to throw a shadow or otherwise; but with this light there will be no difficulty of that sort, as a single small speculum no larger than a hat will send it in any direction we please; and it is wonderful what advantages, by reason of its small bulk, we have in the consideration of the different kinds of apparatus required, reflecting or refracting, irrespective of other reasons for using the electric light. And it is these kind of things which make us decide most earnestly and carefully in favour of the electric light.

I am going to show you the effect that will take place with that large lens when we throw the oil lamp out of action, and put the electric light into use. It is astonishing to find how little the eye can compare the relative intensities of two lights; look at that screen and try to recollect the amount

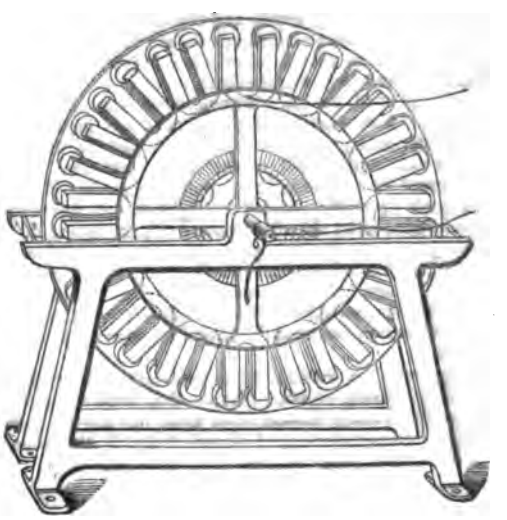
Fig. 4.



of light thrown upon it from the $3\frac{3}{4}$ inch lamp of Fresnel, and now, when we shift the lens sideways, look at the glorious light arising from that small carbon point (*fig.* 4.); see how beautifully it shines in the focus of that lens and throws the rays forward. At present the electric light is put at just the same distance as the oil light, and therefore, being in the focus of the lens, we have parallel rays which are thrown forward in a perfectly straight line, as you will see by comparing the size of the lens with that of the light thrown on the screen. You will now see how far we can affect this beam of light by increasing or diminishing the distance of the lamp. We are able by a small adjustment to get a beam of a large or small angle, and observe what power I have now over it; for if I want to increase the degrees of divergence, I am limited by the power of light in the case of the oil lamp, but with the electric light, I can make it spread over any width of the horizon by this simple adjustment. These then are some of the reasons which make it desirable to employ the electric light.

By means of a magnet, and of motion, we can get the same kind of electricity as I have here from the battery; and under the authority of the Trinity House, Professor Holmes has been occupied in introducing the magneto-electric light in the lighthouse at the North Foreland; for the voltaic battery has been tried under every conceivable circumstance, and I take the liberty of saying it has hitherto proved a decided failure. Here, however, is an instrument wrought only by mechanical motion. The moment we give motion to this soft iron in front of the magnet, we get a spark. It is true in this apparatus it is very small, but it is sufficient for you to judge of its character. It is the *magneto-electric* light, and an instrument has been constructed as there shown (*fig.* 5.)

Fig. 5.



which represents a number of magnets placed radially upon a wheel — three wheels of magnets and two sets of helices. When the machine, which is worked by a two-horse power engine, is properly set in motion, and the different currents are all brought together, and thrown by Professor Holmes up into the lantern, we have a light equal to the one we have been using this evening. For the last six months the North Foreland has been shining by means of this electric light — beyond all comparison better than its former light. It has shone into France, and has been seen there and taken notice of by the authorities, who work with beautiful accord with us in all these matters. Never for once during six months has it failed in doing its duty; — never once, more than was expected by the inventor. It has shone forth with its own peculiar character, and this even with the old apparatus —for as yet no attempt has been made to construct special reflectors or refractors for it, because it is not yet established.

I will not tell you that the problem of employing the magneto-electric spark for lighthouse illumination is quite solved yet, although I desire it should be established most earnestly (for I regard this magnetic spark as one of my own offspring). The thing is not yet decidedly accomplished, and what the considerations of expense and other matters may be, I cannot tell. I am only here to tell you as a philosopher, how far the results have been carried, but I do hope that the authorities will find it a proper thing to carry out in full. If it cannot be introduced at all the lighthouses, if it can only be used at one, why really it will be an honour to the nation which can originate such an improvement as this,—one which must of necessity be followed by other nations.

You may ask, what is the use of this bright light? It would not be useful to us were it not for the constant changes which are taking place in the atmosphere, which is never pure. Even when we can see the stars clearly on a bright night it is not a pure atmosphere. The light of a lighthouse, more than any other, is liable to be dimmed by vapours and fogs, and where we most want this great power, is not in the finest condition of the atmosphere, but when the mariner is in danger, when the sleet and rain are falling, and the fogs arise, and the winds are blowing, and he is nearing coasts where the water is shallow and abounds with rocks—then is his time of danger, when he most wants this light. I am going to show you how, by means of a little steam, I can completely obscure this glorious sun, this electric light which you see. The cloud now obscuring the light on the screen is only such a cloud as you see when sitting in a train on a fine summer's day; you may observe that the vapour, passing out of the funnel, casts as deep a shadow on the ground as the black funnel; the very sun itself is extinguished by the steam from the funnel, so that it cannot give any light; and the sun itself if set in the lighthouse would not be able to penetrate such a vapour.

Now the haze of this cloud of steam is just what we have to overcome, and the electric light is as soon, proportionally, extinguished by an obstruction of this kind as any other light. If we take two lights, one four times the intensity of the other, and we extinguish half of one by a vapour, we extinguish half of the other, and that is a fact which cannot be set aside by any arrangement. But then we fall back upon the *amount* of light which the electric spark does give us in aid of the power of penetrating the fog, for the light of the electric spark shines so far at times, that even before it has arisen above the horizon twenty-five miles off, it can be seen. This intense light has therefore that power which we can take advantage of,—of bearing a great deal of obstruction before it is entirely obscured by fogs or otherwise.

Taking care that we do not lead our authorities into error by the advice given, we hope that we shall soon be able to recommend the Trinity House, from what has passed, to establish either one or more good electric lights in this country.

PHARMACEUTICAL SOCIETY, 7 *March* 1860.

(*Continued from p.* 161.)

Dr. Redwood made a verbal communication *On the Composition of Hydrargyrum cum Cretâ.* He said that in a former communication he had stated the results of his experiments, undertaken to ascertain whether arsenic or antimony was ever contained in Hydrargyrum cum Cretâ. He had not been able to find either of these substances in any of the specimens he had examined. In the course of the investigation, however, another and very important question had been suggested, viz. "What is the real nature and composition of Hydrargyrum cum Creta?" It is always said to be a mixture of chalk and finely-divided mercury, with sometimes a small proportion of protoxide of mercury; but in no publication is the amount of the last said to be more than a fraction of a grain per cent. Dr. Nevins had found rather more than one half per cent. and others had arrived at the same result. In his previous communication Dr. Redwood had stated his belief that the more violent and prolonged trituration to which the mercury was subjected in the preparation of grey powder by machinery most probably resulted in the formation of a much larger amount of the protoxide, which he thought would account for the dangerous symptoms at times produced by the medicine. The analysis of several specimens had shown that this was really the fact. On treating these specimens with acetic acid he had found that the filtered liquor contained abundance of acetate of the protoxide. But in the course of the investigations a still more important matter had been revealed—the presence of a considerable proportion of the peroxide of mercury. The analyses showed, in fact, that the preparation had no uniform composition. That it might sometimes be a mild and at other times a dangerously active medicine. According to Pereira the protoxide of mercury is the least irritating of mercurial preparations, never producing disorder in the intestinal canal; but the peroxide is a powerful irritant. The effects of Hydrargyrum cum Cretâ, then, depend on the presence of these two oxides. If only protoxide be present the action will probably be mild; but if it contain peroxide it may be dangerously active. In order to discover what was the real composition, a number of samples had been submitted to analysis, and the results of some will be found in the following table:

	Hg.	HgO.	HgO_2
1.	37·1	0·4	trace
2.	32·5	3·74	1·45
3.	27·9	4·99	5·18
4.	20·4	13·1	4·86
5.	21·7	7·9	8·85
6.	13·1	11·64	14·25

The sample No. 1 was made by rubbing the mercury and chalk together in a pestle and mortar, which was the proper way of preparing the medicine.

The methods used for determining the amount of the two oxides were as follows:—The specimens were first treated with warm dilute hydrochloric acid, which dissolved the peroxide, forming corrosive sublimate, and converted the protoxide into calomel, which was left behind with the metallic mercury. The amount of peroxide was obtained from the bichloride in solution. The amount of protoxide could be calculated from the chloride left after dissolving the metallic mercury with dilute nitric acid; but in these cases another plan had been adopted. A separate portion of the Hydrargyrum cum Cretâ was treated with hydrocyanic acid, which converted the whole of the peroxide and half the protoxide into cyanide, and left the other half of the protoxide behind in the form of metallic mercury. The difference obtained by subtracting the weight of peroxide obtained from the bichloride and that obtained from the cyanide calculated into protoxide and multiplied by two, would of course give the amount of the whole of the protoxide contained in the specimen.

A reference to the table will show how different was the composition of the samples examined. No 1 was a harmless preparation; but No. 6 was poisonous. How was the presence of this large amount of the peroxide to be accounted for? In the first place it could not be doubted that by the use of the steam engine, the action of which was continued for days, a large quantity of protoxide was formed. If it remained in this state the medicine would still be harmless. But, unfortunately, if safe and mild when first prepared, it cannot be kept so: for by the action of light the protoxide is converted into the peroxide and metallic mercury, and thus a dangerous ingredient, never intended to form part of it is introduced into the preparation. In Pilula Hydrargyri no protoxide could be discovered—the mercury being protected from oxidation by the saccharine matter of the confection; and probably the best method of preparing the Hyd. c. Cret. would be that of the Dublin Pharmacopœia, which orders the mercury to be first triturated with manna before it is rubbed with the chalk. The efficacy of the medicine probably does not depend on the protoxide. We have no

chemical evidence that anything more than mercury in a fine state of division is to be found in blue pill, and yet it is known to be an active mercurial.

Dr. Redwood intends to make further investigations before the next meeting, when the subject will be fully discussed.

The Chairman said the subject was one of great importance to the medical profession. Dr. Redwood's experiments went to show that a medicine in great repute was no longer the same it used to be. Although greatly changed in composition, but slight alteration took place in the appearance, and that could only be detected by the use of the microscope.

The meeting then adjourned.

SOCIETY OF ARTS, *Wednesday, 7 March* 1860.

J. Bennet Eames, *Esq., F. R. S. in the Chair.*

At this meeting Mr. Alderman Mechi read a paper *On the Application of Town Sewage to Agriculture*, but we do not think that a detailed account of the proceedings would either interest or instruct our readers, the paper itself being little more than a statistical catechism of farm operations, together with copious extracts from the opinions and writings of Mr. Eames, Dr. Voelcker, and others. Mr. Mechi advocated a complete system of inland irrigation with the *liquid manure* of towns, and endeavoured to prove that the latter contains the necessary elements in a far more concentrated state than other matters usually employed for the purpose, and diluted by rain—an ingenious, but somewhat unfortunate idea. The bitumenised paper pipes of Messrs. Jaloureau & Co. of Paris (Chemical News, p. 120) were exhibited and noticed as well adapted for both the fixed and "travelling" irrigation recommended in the paper.

In the discussion which followed the reading of the paper, some of the most diverse opinions were put forth by various speakers, but few however possessing any practical character. Mr. Mechi was on the whole well supported by Messrs. Robert Rawlinson and P. H. Holland who corrected some erroneous assertions of Mr. Sidney and other speakers. We will give one instance, a rather amusing one: Mr. Holland said—"he would, in conclusion, only allude to the fallacy which Mr. Sidney had put forth upon the authority of Mr. Hawksley; that gentlemen, an engineer, had put forward a notion which must be astounding to every chemist. It was this—'*that if sewage ran away for a distance of about* 10 *miles, it was no longer sewage, but almost plain water.*'" The readers of the Chemical News will probably agree with Mr. Holland on this point. Without agreeing in detail with Mr. Mechi, we think his paper will do good, and regret that the form in which it appears is not very well adapted for general circulation; but those who are interested in the question of the extended application of sewage, may study it at length in the *Journal of the Society of Arts*.

Mr. Mechi is evidently too sanguine in his views and expectations, but ridicule can only be successfully met in this way, and a little extra enthusiasm often does a world of good.

NOTICES OF BOOKS, PATENTS, &c.

Experimental Researches in Chemistry and Physics, by Michael Faraday, *D. C. L., F. R. S., &c. &c. &c.* London: Taylor & Francis. 1859.

We once thought that there was something terrible in the idea of the unsympathising nature of matter. But we almost begin to think that there are some in whom the promise has been fulfilled that they "shall be in league with the stones of the field." To those who earnestly love matter, not *as* matter, but as a storehouse of wondrous forces, as a fountain from which unfailing draughts of sweet knowledge may be drunk by the nature seeking; matter is not unsympathising. Nature is well represented as a woman, for not only does she bestow her favours capriciously and unequally among her worshippers, but those upon whom she smiles are generally jealous of their fellow-devotees. Of all jealousies this surely is the least evil, only those who worship nature and seek her with untiring zeal can know the sadness of only receiving an occasional, and perhaps faint smile. Her smiles are discoveries.

It is very interesting and instructive to observe how those who have penetrated furthest within the veil, those who have accumulated the greatest number of facts, avoid dogmatic theorising. Far be it from us to despise theories or their inventors, the discovery of facts necessitates the construction of theories to connect them, and enable us to push on in hope of accumulating more. The great man whose discoveries now lie before us is a most instructive example of the fertile discoverer and the cautious reasoner. Ever since the time when providence placed him in the laboratory where he has almost unceasingly worked, he has given to the world at intervals of varying duration the results of his researches, and there has perhaps never been a philosopher whose results have been so uniformly accurate. His constant succession of discoveries has placed him in so elevated a rank in science that any theoretical [assertions he might utter, would by a vast number of his admirers be received with implicit faith. This, in most men's hands would be a dangerous power to wield; but happily for the progress of science in this country, the power has scarcely been used, never abused. Every one knows that in France there has always, from the time of Lavoisier, ay, and even before that, been an authority in science as in politics, who has exercised despotic sway. If any man in this country has had the power of taking this position that man has been Faraday; but content with gleaning rich harvests of facts from the ripe fields of chemistry and physics, and with expounding those facts to the world, he has confined himself to his mission. And a glorious mission it has been; we can conceive no higher, no happier destiny on this earth than the successful study of the wondrous and wondrously beautiful properties of matter. It is impossible to read his works without instantly catching the spirit of enthusiasm which breathes in every page. This appears to be one of the great secrets of his success as a lecturer, he so intensely enjoys the outward signs of the concealed forces that his enjoyment is communicated to his audience. They see with him that "the glorious spark" is but a manifestation of those intense energies which, pervading all matter, have been evoked to do man's bidding, and although his servants, as being at his command, are his masters from the manner in which they influence his destiny.

The work before us opens with a paper which will, while the scientific literature of this country lasts, be read with a high degree of interest. Not that it is especially remarkable for scientific accuracy as an analytical work, or even from the somewhat curious fact it for the first time announces, but as being the paper which introduced Faraday to the world. It is an "Analysis of Native Caustic Lime." The next paper is valuable as opening up a subject which has, in the hands of Graham and Bunsen led to results of great importance; it is "On the Escape of Gases through Capillary Tubes." We pass over a number of communications, each, however, containing matter at the time of high interest, and proceed to his paper "On Two New Compounds of Chlorine and Carbon, and on a New Compound of Iodine, Carbon, and Hydrogen." Almost at the commencement of this research the fact is stated that the oil of olefiant gas is formed by the union of equal volumes of chlorine and the hydrocarbons. In these days when the action of the halogens upon organic bodies has been studied so minutely, we are liable to look over the importance of an experiment demonstrating that four volumes of chlorine and four volumes of olefiant gas united to form the oil of the Dutch chemists. We then have the results of his examination of the action of free chlorine and sunlight upon the oil, the final result being the important discovery of the sesquichloride of carbon. It

is true that it was reserved for more recent researches to ascertain the successive steps of substitution by which the compound is produced. Faraday, from his analysis, therefore deduced C_2Cl_2 as the simplest formula consistent with whole atoms. We now know that the formula must be written C_4Cl_6. We next have the discovery of the protochloride of carbon, and, as with the last, Faraday wrote the formula in the simplest manner, namely CCl; now we know from the mode of derivation, and more especially from its vapour density (5·82), that the above formula must be multiplied by four to give the true formula, which has a theoretical vapour density of 5·81.

Passing over the papers which intervene, we at once spring to the beautiful researches upon the liquefaction of the gases. The whole of the papers upon this subject are models, not only as to the mode in which researches should be carried out, but for the exquisite candour and fairness with which the results of others are given. Now that gases are generally acknowledged to be merely the vapours of intensely volatile liquids, we are apt to forget the freshness and novelty which the scientific public found in the subject. Philosophers, even including our author, began at once to speculate upon the liquefaction, and even solidification, of the two great archetypal gases, oxygen and hydrogen. As yet we have not had a realisation of this great problem, but, undoubtedly, it will one day be done by an extension of the same principal as that by which successful results were obtained with other gases. Every one is aware of the analogy of hydrogen to metals, that is to say, that in the types of water, ammonia, ammonium, and hydrogen (HH), metals and two volumes of hydrogen can be made to replace each other to an almost unlimited extent. It was this which led Dumas to believe that solidified hydrogen would resemble a metal in appearance. This, however, is a very unnecessary speculation, inasmuch as metallic lustre is not a character of great philosophical importance, and it is quite as likely that solidified hydrogen may be a transparent colourless solid.

We shall allude to only one more subject, namely, the experiments on the preparation of silicated borate of lead or heavy glass. This glass has now acquired almost sacred interest, owing to the fact of its having been the substance used by Faraday in his experiments on the illumination of the magnetic lines of force.

Of Faraday as chemist, physicist and philosopher it is difficult to speak analytically. It may indeed be said of him as of poor Goldsmith (and in a far higher sense) that he has left nothing untouched, and touched nothing without adorning it. If there be any true line of demarcation between chemistry and physics, if therefore we can speak separately of Faraday as a chemist and physicist, we should say that he was *one* of the most brilliant chemists and *the* most brilliant physicist the world has as yet seen, — shall we ever see a greater?

Improvements in the Manufacture of Gas. William Knapton and Adam Aitchison.

The inventors subject to dry distillation the refuse bark of tan pits or the bark of trees, wood of all kinds, in fact, and collect the gas evolved, which they say is "a pure hydrogen gas" with nearly the same illuminating power as coal gas, but without its unpleasant smell. In order to give the gas produced the greatest illuminating power they pass it over or through naphtha or camphine when it will give out a more brilliant light than coal gas. The inventors claim as their invention the manufacture of gas from all sorts of timber refuse. The patentees say nothing about the purification of the gas, but our readers will remember a communication from Mr. Proctor in our last number (p. 155) relative to the use of the spent bark of tanneries, in which that gentleman says it is necessary to pass the gas through milk of lime — a necessity which of course any chemist would have recognised.

Improvements in treating Ores to obtain a new Metallic Substance and its Salts, and in the application of such Matters, and also certain Products of Tungsten in Dyeing, Printing, and Painting. F. W. Emerson.

This consists: 1. In the separation of a metallic substance, which the inventor designates "chrolithineum," from wolfram, tungstate of lime, tungstic oxide, and other ores of tungsten, and in the manufacture and application of its various salts to dyeing textile fabrics, painting on porcelain, and the production of paints and pigments. 2. In the manufacture and application of the blue oxide of tungsten as a dyeing substance for textile fabrics, and as a paint or pigment. 3. In the production of paratungstate of alkali, metatungstate of alkali, isotungstate of alkali, and polytungstate of alkali, which may be used in the preparation of paints and pigments, and for dyeing textile fabrics, and for other purposes, and in the combination of paratungstic, metatungstic, isotungstic, and polystungstic acids with any suitable metallic oxide or mixtures of metallic oxides as a base, such as the oxides of lead, zinc, barytes, lime and others, to form paints and pigments.

Powder or Mixture for Refining and Steelifying Iron. (A communication.) R. A. Brooman.

The important part that carbon plays in the conversion of iron into steel is at the bottom of all existing modes of operating, and the inventor of this process fancies that he has discovered a new means of fixing this element in its purest and most convenient form. Accordingly he exposes quick lime to the atmosphere to absorb carbonic acid and to be made use of in the manner we shall presently see. The inventor further states that it is a well known fact that the Danemora iron of Sweden, which furnishes the best steel, contains a notable quantity of phosphorus to such an extent indeed that when bent or twisted at a dull red heat, it gives out a strong odour of phosphorus. From this and other facts Brande and other practical chemists maintain that the presence of phosphorus is essential to the production of first-rate steel, and the inventor's own experience leads him to the same conclusion. So with a view of adding phosphorus to the iron, bone dust is used. The powder which is patented is composed of equal parts of caustic lime, bone dust and charcoal, oak being preferred. These are mixed together and then exposed to the air for two or three days in dry weather. The iron to be operated on is placed with the powder in a cementing or converting furnace, which is then luted up, and heat is applied, and maintained at an equable and not too elevated temperature. By this means the inventor is enabled to give iron entirely new properties and qualities, as well as to convert it or partially convert it into steel at pleasure. Iron treated in this way assumes great rigidity and hardness without losing its properties of malleability and ductility. Any articles large or small may be finished in iron and then converted or partially converted into steel without impairing their forms. The process also gives iron the property of resisting oxidation in a high degree.

CORRESPONDENCE.

Nutritive Properties of Aluminised Bread Food.

To the Editor of the Chemical News.

Sir, — In reply to a letter in your journal of March 3, will you allow me to say that it is scarcely to be expected that I should reply to anonymous correspondents, however kindly and courteously the queries are put. Remarks besides made at a public meeting, and necessarily reported in abstract, can after all only convey a very inadequate account of what was said. I will however on this occasion endeavour to reply to Common Sense, but must altogether decline a paper war.

The statement that alum renders bread indigestible and forms an insoluble salt with phosphoric acid is given on the authority of Liebig. I am therefore content to leave Common Sense to fight his battle with that distinguished German chemist. Still I may say that as all admit that a certain amount of free acid and phosphates is essential to the metamorphosis of tissue, it is chiefly the free phosphoric acid which is taken up by the alum, and thus in great measure lost to the system; and we learn from Erdmann's analysis of the ashes of wheat, deducting 1·33 of peroxide of iron, and 33·7 of silica or sand per cent. that there exists in 100 parts (Liebig):

Alkaline phosphates (PO_5MO)	49·18
Earthy ditto (PO_52MO)	23·13
Free phosphoric acid	27·69

Now as from a mean of seven experiments 100 parts of wheat flour contain 1·83 of salts, 1 lb. of flour would contain 128 grs. of salts, 34·3 grs. only would be free phosphoric acid. The amount of phosphoric acid thus converted into phosphate of alumina would vary according to the amount of alum used, and this, I believe (if the bread be made with musty or inferior flours, no uncommon event in large towns), would far exceed 2 oz. in 56 lbs.

Moreover the so said solubility of phosphates of alumina in organic matters of digestion (even if true for adults) remains to be proved for infants. Certain it is many infants become thin, pale, emaciated, on aluminised bread, while they thrive on home-baked bread which contains no alum. Dr. Hassall moreover has proved that nearly all the London bakers' bread does contain alum. Now facts are stubborn things.

Secondly, the appearance of an atrophied child is not unlike that of an opium eater. If Common Sense has ever seen a child habitually drugged with opium by an unprincipled nurse, he will have found the resemblance between such a child and one poisoned by aluminised bread to be very great. The march of symptoms differs, but the result upon the frame is very similar in both cases. So far it is true alum is as sure a poison as opium, if long persisted in. Both hasten death by atrophe.

What I stated in my remarks at the Hanover Square Rooms was that "chloride of potassium, at any rate, potash salts," were essential in cell growth. On the latter point the latest German writers agree. That the potash salt is the chloride of potassium is *my* belief; but I do not wish to anticipate here views not yet complete, but which I hope ere long to publish. Whatever takes place however in the vegetable kingdom in regard to the natural substitution of chlorides of potassium and sodium certainly does not as invariably hold good in the animal kingdom. It is not by accident that so much chloride of potassium is found in muscle and its juices, and so little of chloride of sodium; and so much of the latter salt and so little of the former in the blood. Again, although in an adult it may be reasonable to admit that it is equally advantageous to supply a potash salt as a chloride, phosphate, or sulphate; yet, as in milk, *the* food *par excellence* for a babe, potash is supplied only as a chloride, the fact implies an advantage if not a necessity for this, although as yet we may not be able to explain the reason.—I am, &c.

C. H. F. Routh, M.D.

Observations upon the Phenomena of Heat and Sound, with reasons for supposing them identical both in nature and operation.

To the Editor of the Chemical News.

Sir,—In commencing any physical inquiry, one of the first things to be noticed is, that law declared by Newton with reference to the adequate, and not more than adequate, conception of cause with relation to effect. We should never receive into our idea of cause anything which does not appear necessary to explain the effect produced. I apprehend that this precept has been greatly overlooked, and that the phenomena about to be noticed present striking examples of this. It is true that they are of a nature which apparently renders their investigation most difficult. Nevertheless, I think that the want of success which has characterised the labours of others who have studied them, has greatly helped to make the interpretation of these phenomena appear more difficult than is really the case. I remark that our knowledge of all such phenomena has been overrated. Philosophers assuming connection where none can be proved to exist, or fancying complication of effect, both being with a view to render phenomena explicable. As regards heat, everyone is aware that the term expresses something, our conception of which is indefinite; that is of the phenomenon itself, as separated from our sensation of it, or its effect. If we suppose that heat is something apart from the sensation of the friction of some substance, I apprehend that we go farther than ascertained and universally acknowledged facts will carry us. Let us see what is the utmost we know concerning this phenomenon. It is found that in various ways we become acquainted with the sensation termed heat, but I think that in no case have we evidence of the presence of any new substance. Under ordinary circumstances the friction of the atmosphere appears to me sufficient to account for every manifestation of heat. The hypothesis which considers heat as motion among the particles of bodies, appears to me capable of explaining the change of water into steam and ice. This action may cause the particles of water mutually to repel each other in the case of steam, which friction, growing dead, may cause water to assume that condition known as ice. The production of heat by friction appears to me to afford a very strong argument in favour of this hypothesis, especially as frictional heat has been produced in an exhausted receiver. The fact of heat having traversed the Torricellian vacuum proves that the friction of the atmosphere does not cause it, but I submit that this does not *per se* establish the existence of a new element. I think that the vibrations of some element which cannot be disposed of in the same way as air may affect the enclosed thermometer; and that it is as probable that this is the case as that the so-called heat is produced. From an experiment of Sir H. Davy, it appears that in a considerably attenuated atmosphere, the heat caused by a piece of platinum wire, charged with voltaic electricity, was three times as great as it was in air of the natural density. This proves that the atmosphere in its ordinary state is unfavourable to its production, but I do not think that it renders probable the hypothesis of a calorific fluid. The attempts to discover whether the application of heat to bodies affects their weight, being of a nature very liable to mistake, and contradictory results having been obtained, it is perhaps best to pass over this consideration; although, if satisfactorily investigated, the conclusion found must evidently be final. The experiment of Berthollet with various metals, proving that their latent heat decreased with their pressure, seems to prove the hypothesis of motion among the particles of bodies. It is natural to suppose that the more bodies are compressed, the less motion will there be among their particles; and consequently, their friction upon the atmosphere or any substance with which they may come in contact will decrease; and its sensation, which we name heat. I think, then, that until some philosopher shall produce a solid reason for supposing the creation of heat, more probable than the hypothesis concerning the friction of some elements, more ethereal than the most attenuated atmosphere, and existing both with it and where this does not, they cannot philosophically assume its presenee.

That the atmosphere, along with every other body, conducts sound, every one admits, although there may be differences as to the conception of the cause of this sensation. Because a bell will not sound in a very attenuated atmosphere, it is concluded that air is necessary for the transmission of sound; and here it appears to me that we have an

example of the error of complicating effects, although it is difficult to see how this renders the phenomenon more intelligible. I apprehend that it has never been demonstrated that the friction of the atmosphere upon the ear is not that which we term sound; and certainly something should be adduced in opposition to this most natural idea, before it is assumed that something is created whenever sound is heard. A bell will not sound in a very attenuated atmosphere because its friction is lost upon it: the medium is too subtle to convey the vibrations in the form of undulations to the receiver, and hence the external atmosphere cannot become affected, and thereby convey to the ear the friction known as sound. There does not here appear to me any necessity for supposing the creation, using the term as before in a generalised sense, of anything, and I cannot think of any phenomena where this hypothesis is in any wise requisite. If the bell is connected with a rod projecting through the top of the receiver, I think I correctly say that its sound will be audible to an ear placed close to the rod. The friction may pass directly from the rod, or affect the atmosphere, and the ear at a little distance.

Thus it appears to me that heat and sound are identical in nature. The consideration of sound being but a name for a sensation, and heat the undulations of some subtle medium, does not render the two phenomena diverse in nature. The one appears to me to depend upon our ordinary atmosphere and other media, and the other upon the undulations of some ethereal element which cannot at present be fully proved to exist, as it cannot be got rid of. Upon the supposition with respect to heat, no generation is required. It cannot be said that, in asuming the presence of an ethereal substance, I take a great licence, inasmuch as this hypothesis involves far less unsubstantial particulars than that respecting a calorific fluid; besides which, seeing no reasons for considering generation with respect to sound, there is from analogy an evidence against supposing it productive of the sensation of heat; and the hypothesis of an ether, from the analogous one respecting the immensity of space being filled with it, does not stand destitute of high probability. Thus the radical nature or constitution of both elements appears the same; and friction being the mode of effect in both cases, as indeed force always produces change, these phenomena are similar in operation.—I am, &c.

J. A. Davies.

Zinc Ore in the form of Oolite.

To the Editor of the Chemical News.

Sir,—I have read with much interest the notice [in a recent number of the Chemical News on *Zinc Ore in the form of Oolite*.

The occurrence of zinc in this form has not, I believe, been recorded as occurring elsewhere than in the neighbourhood of Santander, neither do I recollect any other metal except iron, as "pisolitic ore," taking this form. Many of the mines near Santander produce zinc ores of peculiar structure and composition. I was favoured about eight months since with a small series of specimens from the mines of the Santander Mining Company, and amongst them was a portion of a large stalactite of calamine, containing a large proportion of ZnO. The structure of this stalactite was laminated like the granules mentioned in your notice; the laminæ were easily separated by the finger nail. I see from my note of the analysis that I made, there was a larger quantity of $CaO.CO_2$ than in the granules of which your correspondent made an analysis, as I found as much as 9·63 of this substance.

The other ores I received were chiefly hydrated silicates, and, unlike many of the German or Derbyshire ores, appeared devoid of all traces of cadmium.

Hoping that the writer of the notice will publish any further researches on this subject,—I am, &c.

W. H. T. Allen.

Chemical Nomenclature.

To the Editor of the Chemical News.

Sir,—I have been somewhat surprised to find, from the correspondence upon this subject, that the terms "nitrate of *potassium*," "sulphate of *barium*," &c. are received with so much difficulty. The theory upon which the new formulæ are based is not by any means a recent one, it having been suggested long ago by the sagacity of Davy. Daniell too, and many others, considered nitric and sulphuric acids as the hydrides of salt-radicals, calling them oxynitrion and oxysulphion respectively. The dictional difficulty may be despatched in a few words. "Your Weekly Guest" has proposed "nitratide of potassium" as a suitable term, apparently in ignorance of the fact that several writers have before suggested the termination *aside* for the compounds of all acids ending in *ic*: this certainly has the advantage of euphony at least, which cannot be obtained if a *t* is introduced, but by either of these methods an additional syllable is necessitated, which to my mind would be a disadvantage far outweighing other considerations.

By retaining the old terms, "nitrate," "sulphate," &c. and applying them to the *metal* instead of to the *oxide*, we have at once a concise and accurate arrangement, requiring but a slight mental effort to fall into, for in many instances the nomenclature remains quite unchanged upon this plan, *e.g.* as in "nitrate of copper," "sulphate of zinc," &c. the only alterations required being in those salts where the metallic oxide has a distinctive title of its own. A trifling objection may perhaps be urged against the binary theory when the salts of alkaloids are considered, as sulphate of quinine would have to be written (according to Laurent's version of its composition) $C_{38}H_{24}N_2O.SO_4$, and I am not aware that $C_{38}H_{24}N_2O$ (or perhaps $C_{40}H_{24}N_2O$) has as yet been obtained.—I am, &c.

Wentworth L. Scott.

The Cavendish Society.

To the Editor of the Chemical News.

Sir,—As you were so good as to insert my former letter, may I ask you to publish the financial statement which usually accompanies the Report of the Cavendish Society. I am anxious to see for myself how far this bears out the council in their resolution to publish no more works until *Gmelin's Chemistry* is finished. A careful examination of these statements for a few years past may perhaps enable us to understand better the present position of the Society, and how it was brought into its present condition.—I am, &c.

A Subscriber to the Cavendish Society.

Manchester, March 13.

[The abstract of the Report we published was kindly supplied by the secretary. The entire Report and the balance will no doubt be printed and circulated among the subscribers immediately.—Ed.]

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

On the Colouration of the Salts of Manganese.—M. A. A. Gorgeu has communicated to the Academy of Sciences the results of some investigations into the constitution of the white and rose coloured oxalates of manganese. He has found that they differ essentially in their chemical composition. The rose-coloured salt may be represented by the formula $C_2O_3MnO.3HO$, and the colourless salt by $C_2O_3MnO_2HO$. The affinity for the water of crystallisation is not the same in both salts. The white salt when exposed to the air undergoes no change, but the rose-coloured loses an equivalent of water, and is changed into a white salt $C_2O_3MnO_2HO$. In a vacuum the colourless salt does not lose weight, while the rose salt parts with some of its water, but does not lose its colour and transparency. When dried

in a stove about 95° C. the white salt remains unaltered, but the red parts with $\frac{2}{10}$ of its water, and keeps only a faint rose tint. The author believes that the simultaneous existence of a rose-coloured and white oxalate is not opposed to the hypothesis which attributes a characteristic colouration to the salts of manganese, since the absence of colour in the oxalate with 2HO may result from chemical and physical differences, which exist between it and the rose-coloured salt.[1]

Preparation of Pure Platinum Black.—M. C. Brunner ainé[2] heats in a capsule dry oxalate of iron until the oxalate is completely changed into oxide, which is reduced in a current of hydrogen. The reduced iron is then added by degrees to a dilute and slightly acid solution of chloride of platinum, until the liquid becomes colourless. The precipitate is treated repeatedly with boiling concentrated nitric acid to remove all traces of iron, and is then washed with weak potash and with water. The black powder so obtained, when heated on platinum foil, suddenly becomes red hot, increases in volume, and is changed into spongy platinum. The same transformation takes place when it is moistened with a few drops of alcohol.

II. ORGANIC CHEMISTRY.

Urate of Quinine.—A physician of Bordeaux who had observed that obstinate cases of intermittent fever which were not relieved by large doses of the sulphate of quinine quickly recovered when the patients drank some of their own urine, came to the conclusion that urate of quinine was a valuable medicinal agent—an idea which, according to Dr. Fleury[3], experience has confirmed. The urate is formed by combining 10 parts of rough quinine with 20 parts of uric acid. The quinine is placed in distilled water and boiled for 10 minutes; the uric acid is then added by degrees and the ebullition continued for an hour, during which time the mixture must be frequently stirred, and fresh quantities of distilled water added. The liquid is filtered off and the marc again boiled in more distilled water for 20 minutes longer, and then filtered. The filtrates are united and evaporated to dryness. In this way a salt is obtained of a beautiful yellow colour, sometimes amorphous, but more frequently crystallised in brilliant spangles. Urate of quinine is soluble in boiling or even warm distilled water, and slightly so in cold water. It is said that smaller doses than are given of the sulphate will cure intermittents, and that the exhibition of it is not followed by the same cerebral disturbance.

Action of Tannin on Ether and Water.—M. Luboldt[4] says that tannin loses more or less water when heated on a bath of chloride of zinc according to the manner in which it has been prepared. When obtained by the method of Pelouze, it loses only 10 per cent. of water, but when evaporated from an aqueous solution it loses 12·85 per cent. Thus dried tannin gives up to *absolute* ether from 2 to 3 per cent. of fixed principles composed of a mixture of tannin, gallic acid, ellagic acids, and fatty and resinous substances. These relations are a little changed when water intervenes. At first anhydrous tannin has a great affinity for water, which it seizes upon and then dissolves in its own weight of ether, forming a syrupy liquid which in the process of Pelouze constitutes the inferior layer. On this pure ether has no action, but if enough water be added, the tannin forms a viscous mass with the two liquids. The results varying according to the proportion of water employed, led the author to believe that they might be occasioned by the property which ether and water have of dissolving one in the other. He found in fact that the syrupy liquid only yielded $\frac{1}{10}$ its weight to water saturated with ether. The three layers obtained by treating tannin with ether and water according to the author are—1, the lower, ether dissolved in hydrate of tannic acid; 2, the second, the syrup liquid of hydrate of tannic acid, dissolved in etherated water; and 3, the same composition containing the fatty and resinous matter.

[1] *Le Moniteur Scientifique*, 1 Mars 1860.
[2] *Idem.*
[3] *Journ. de Pharm. et de Chimie*, Fév. 1860.
[4] *Journal für Praktische Chemie*, Bd. lxvii. s. 357.

III. CHEMICAL ANALYSIS.

New Process for the Decomposition of Silicates. When silica having a density of 2·2 (see CHEMICAL NEWS, p. 118) is mixed with two or three times its weight of fluoride of ammonium, and the mixture heated in a platinum crucible, the silica is completely volatilised in the state of fluoride. This does not take place so easily with quartz and sand. Rose[5] points out that the fluoride of ammonium may be employed for the decomposition of silicates. It is easily made by saturating hydro-fluoric acid with ammonia. The impure acid, which generally contains some fluoride of silicon, lead, and iron will answer for the purpose. A small quantity of carbonate and hydrosulphuret of ammonia must be added to the solution, which after a time is decanted and evaporated in a platinum crucible. During the evaporation a small piece of carbonate of ammonia must be added from time to time. When the mass becomes pasty it must be stirred with a spatula. When well dried the salt may be kept in vessels of platinum, silver, or gutta-percha.

The silicate must be very finely pulverised, and mixed with six times its weight of the fluoride, and little water is then added and the crucible is heated at first gently, and then to bright redness, at which it must be maintained as long as vapours are disengaged. A single operation will generally complete the decomposition. The residue is treated with sulphuric acid, and the excess of this acid is driven off evaporation. When the sulphates formed are not completely dissolved by water acidulated with hydrochloric acid, the insoluble residue must be treated with a fresh portion of the fluoride. The temperature should not be raised too high during the operation, for in that case if the silicate contain alumina, a fluoride of aluminium will be formed, difficult to decompose by sulphuric acid.

IV. TECHNICAL CHEMISTRY.

The Bleaching of Paper.—M. Didot[6] has found that by passing a current of carbonic acid gas through the pulp subjected to the action of hypochlorite of lime, the time occupied in the bleaching is reduced one half. M. Didot has invented an ingenious apparatus by means of which he is enabled to make use of the carbonic acid from the chimney freed from the soot and other matters which accompany it.

[5] *Poggendorff's Annalen der Physic und Chem.* Bd. cviii. s. 20.
[6] *Le Moniteur Scientifique*, 1 Mars 1860.

SCIENTIFIC NOTES AND QUERIES.

Estimation of Mixtures of Acids or Alkalies in Solution.—SIR,—An error should be promptly acknowledged when pointed out. I have just received the CHEMICAL NEWS, No. 13, and feel much obliged to your correspondent who has there pointed out—what I through inadvertence neglected to observe—that in the method which I proposed in No. 9 for estimating mixtures of acids and alkalies, the equations are not really distinct, and consequently the method is worthless.—*E. G.*

LABORATORY MEMORANDA.

New and Easy Mode for Condensing Carbonic Acid on the Small Scale.—Take a piece of glass tubing about 10 inches long and ¼ inch in diameter, close it at one end before the blowpipe; then heat about an inch of it in the middle of its length, so as to bend it easily; and when it is sufficiently heated, with the one hand press upwards and with the other downwards, so as to produce parallel lines with the two ends of the tube at the distance of about half an inch. One part of the tube is by this means raised above the other, whilst the middle

forms as it were a common bent neck to two bottles. This done form to the open end of the tube a good rim which can afterwards be used for fixing a good cork, previously besmeared with putty. When the apparatus is made, introduce by means of a tube syringe into the sealed end half a drachm of pure concentrated sulphuric acid, taking care that the sides of the upper part of the tube are not wetted by the acid; this done, incline the tube so as to keep the acid in the lower end of the tube, and introduce by a fine spatula 2½ scruples of powdered carbonate of ammonia, taking great care not to shake any of it into the acid before the open end has been closed by the cork and secured with copper wire to the rim of the tube. As soon as the tube is thus securely closed, shake the whole of the carbonate of ammonia into the acid and press the tube upon a bladder filled with a freezing mixture, so as almost to bury it in the bladder. The whole may then be covered with a glass bell to prevent the action of the surrounding atmosphere. In placing the tube upon the freezing bladder care must be taken to incline the upper part of the tube so that the condensed carbonic acid can collect in the upper portion of the bent neck. By this manipulation a small quantity of condensed carbonic acid can be prepared in ten minutes, and if the glass tubing chosen for the apparatus be sufficiently strong it may be washed out and used again and again.—*Edward R. H. Unger, Ph.D.*

MISCELLANEOUS.

Coal-oil manufacture in America.—An approximative estimate of the quantity of illuminating coal-oil manufactured daily in the United States, during the month ending December 31, 1859, exhibits the following figures: —

Name or place of works.	*gals.*	*Name or place of works.*	*gals.*
Downer, Boston, Mass.	1,500	K. C. C. M. & O. M. Co.	
Glendon, Boston, Mass.	1,000	Kanawha, Va.	300
East Cambridge, Mass.	800	G. R. C. & O. Co. Kanawha, Va.	300
Page & Co. Mass.	600		
Suffolk, Mass.	300	Greer, Kanawha, Va.	200
Portland, Maine	500	Staunton, Kanawha, Va.	—
New Bedford	300	Atlantic, Kanawha, Va.	—
Hartford, Conn.	200	Maysville Co. Ky.	400
Kerosene, New York	2,500	Union Co. Ky.	600
Columbia, New York	800	Ashland, Ky.	—
Carbon, New York	300	Covington, Ky.	—
N. Y. C. O. Co. New York	400	Breckinridge, Ky.	250
Empire State, New York	200	Newport, Ky.	300
Several others in New York	500	Eureka, Cincinnati, Ohio	600
Philadelphia, Pa.	500	Rosecrans & Co. Cincinnati	300
Pittsburgh (four firms)	2,000	Phœnix, Cincinnati	200
Great Western, Ohio	500	St. Louis, Mo.	200
Newark Region, Ohio	2,500	Otherwise	3,500
Wheeling, Va.	200		
	Total number of gallons daily		22,750

We will not assert that the estimate is quite correct — some establishments are probably over, others underrated; yet we believe that the sum total is a pretty close approximation to the actual quantity of burning coal-oils now made daily in this country. The produce of the oil-springs has been omitted, as a reliable statement about their produce could not be procured. We will now draw a few general conclusions. It is presumed there have been sold by the several manufacturers of coal-oil lamps and burners from 250,000 to 300,000 dozen burners and lamps, of which about 150,000 dozen are in use, the balance being in the hands of dealers. A coal-oil lamp will consume about 4 gallons of oil during the year. The amount of oil burned by the above 1,800,000 lamps is consequently 7,200,000 gallons per year, or about 20,000 gallons every day. This shows that the amount of oil manufactured is in advance of that consumed.

In order to make 22,750 gallons of burning oil it will require 75,000 gallons of crude coal-oil, to make which requires 60,000 bushels of cannel-coal.

It will cost, to build crude-oil and refining works, to make the named quantity of oil each day, 3,000,000 dollars; but the actual outlay for the oil-works at present at work, does not fall short of 8,000,000 dollars.

The value of chemicals used in the purification of coal-oil will amount to over 2000 dollars per day.

The number of barrels used to hold coal-oil will be between 500 and 600, representing the value of 1000 dollars, and the labour of 400 men.

The value of the burning coal-oil itself will amount to over 16,000 dollars per day, or more than 5,000,000 a year.

All of this does not include heavy oil and paraffin, the sale of which is limited and uncertain.

The number of workmen employed in the several coal-oil works in this country will reach 2000; that of miners engaged in mining cannel 700 or more. Besides this, there are a large force of men employed in making lamps, burners, wicks, chemicals, &c.

If we take into mind that two years ago there were only two or three oil-works in this country, the above statements form a strong illustration of the impetuous energy with which the American mind takes up any branch of industry that promises to pay well. As far as coal-oil is concerned, the rapidity with which the manufacture of this beautiful illuminator has been propagated amounts (like the cultivation of the *morus multicaulis*, some years ago) to a mania.—*Scientific American.*

Charge of Manslaughter against a Druggist.—John Reeve a very respectable young man, surrendered to take his trial for the manslaughter of Thomas Benjamin Cole. The prisoner carried on the business of a chemist at Canterbury, and his brother, a youth of seventeen, acted as his assistant. The deceased was a young man, a tailor, at Canterbury, and on the 19th of December he complained of a sick headache, and went to the prisoner's shop and obtained a draught and some pills. On the following day he sent his sister to the prisoner's shop for some more medicine, and he handed her a phial which was supposed to contain the ordinary black draught, and told her that her brother was to take it with the pills. The deceased took the draught as directed, and very shortly afterwards he became very ill, and a medical gentleman named Andrews was sent for, who from the symptoms he exhibited formed an opinion that he was suffering from epilepsy, and he prescribed some remedies which had no effect, and the deceased died a few hours afterwards. A coroner's inquest was held upon the body, when the jury, upon the evidence before them, returned a verdict of "Natural Death." The result of further inquiries that were made, however, left very little doubt that a quantity of opium had been by mistake administered in the draught taken by the deceased. There was, however, no evidence to show by whose hand the draught was made up, and according to the medical testimony the symptoms exhibited by the deceased were more in conformity with the supposition that the death arose from epilepsy than from a narcotic poison. The learned Judge having summed up, the jury, after a short deliberation, returned a verdict of Not Guilty.

Poisoning by Oil of Vitriol.— A man aged 54 was admitted into the London Hospital on March 3, having swallowed about two ounces of strong oil of vitriol. His tongue and lips were whitened and excoriated, and he suffered excruciating pain referred to region of the stomach. Chalk and milk were freely administered, but he died about six hours after taking the poison. The act was suicidal. This made the seventh case of poisoning by one of the strong mineral acids, admitted into the London Hospital within the last few months.

The Adulteration of Food or Drink Bill. — On Wednesday afternoon the House went into committee on the Adulteration of Food or Drink Bill, commencing at clause 4, which was agreed to, as were also clauses 5 to 10. Mr. KER moved that clause 11, limiting the operation of the bill to England, should be struck out. On a division, the motion was negatived by 101 to 88; majority, 13. So the clause was retained. A division was taken on clause 2, the consideration of which had been postponed, and which was adopted by 123 to 16; majority, 107.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

W. M. (Manchester)—We have not yet been able to meet with the information you need. Thanks for the offer.

J. Gordon.—See Gmelin's *Chemistry*, vol. i. p. 286; vol. ii. p. 91; and p. 179 of the present number.

Tyro.—*Garancine* or madder-red is made by treating ground madder root by oil of vitriol. It is used for dyeing.

W. J. J.—A solution of alum will give a white precipitate with chloride of barium and with ammonia. The latter is soluble in caustic potash.

R. A. C.—The most effective poison to use is strychnine. You had better let a chemist prepare it for you.

W. Proctor.—We have a letter for this correspondent. Where shall it be sent?

Books received.—*Cyclopædia of the Physical Sciences*, by J. P. Nicoll, LL.D. London and Glasgow: R. Griffin & Co. *The Comparative Properties of Human and Animal Milk*, by M. A. Baines. London: Churchill.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business* communications to the PUBLISHER, at the Office; 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Simple and Expeditious Method of Estimating Phosphoric Acid and its Compounds, by E. W. Davy *M.B. M.R.I.A. Professor of Agriculture, Agricultural Chemistry, to the Royal Dublin Society.*[1]

The want of a simple and expeditious method of estimating phosphoric acid and its compounds, has long been felt, most of the means devised being tedious and complicated. After much investigation, the author has devised a method founded on the fact that phosphoric acid possesses a great attraction for peroxide of iron. When a persalt of iron is added to a solution containing phosphoric acid an insoluble phosphate is produced. This fact has long been known, and different methods founded on it have been devised by Berthier, Kobell, Raewsky and others, for the estimation of phosphoric acid and its compounds. But as each of those methods requires a considerable time for the collecting, washing, drying, igniting, and weighing of the precipitated phosphate of iron, the author proposes to dispense altogether with those operations by simply adding a solution of iron of known strength to the phosphate, and ascertaining the point when enough has been added to combine with all the phosphoric acid present.

The standard iron solution is made by dissolving clean pianoforte wire in pure hydrochloric acid, and sufficient nitric acid is added to convert the proto- into per- chloride of iron. Any free hydrocloric acid is then carefully neutralised with caustic ammonia, which is added until a little peroxide remains undissolved on shaking the mixture. Acetic acid is now added to dissolve the precipitated oxide, and when the solution is effected the mixture is largely diluted with distilled water and graduated in the ordinary way, so that the amount of iron in a given quantity may be known.

This solution may be kept a considerable time without undergoing change, and is therefore preferable to the acetate and other salts of iron which have hitherto been employed.

The next step is to prepare the phosphate. If insoluble (as is generally the case) it is dissolved in an acid. Ammonia is added until the solution is decidedly alkaline, but not in large excess, and then enough acetic acid to completely redissolve the precipitated phosphate, and leave a slight excess. The standard solution of iron is then carefully added from Mohr's alkalimeter, or any other convenient form of volumetric apparatus, till the iron begins to be in slight excess, which is ascertained by taking a drop of the mixture (after it has remained a few minutes with occasional stirring) on a glass rod, and touching with it a piece of thick filtering paper, placed over another piece of paper which has been soaked in a solution of gallic acid and dried. The insoluble phosphate of iron is retained on the filtering paper and the solution which passes down to the lower shows at once by the purple stain when sufficient iron has been added and a minute excess exists in the mixture. If this excess is very minute, the stain will become more visible when the gallic acid paper is dried. The results should be controlled by repeating this experiment a second and third time, having the phosphate dissolved in a given quantity of solution, and taking a certain amount of it for each determination.

The author's experiments have clearly shown him that under the conditions in which the iron and phosphoric acid are placed, a compound having the uniform composition ($Fe_2O_3.PO_5$) is produced, and therefore the objections hitherto made to the volumetric method of estimating phosphoric acid are obviated. Experiments made with pyrophosphate of magnesia, tribasic phosphate of lime, and anhydrous pyrophosphate of soda, all gave results agreeing closely with the calculated composition, as will be seen by the following table:

Amount of iron required to combine with the PO_5 contained in one grain of

	By calculation, parts of a grain,		By experiment.
Pyrophosphate of Magnesia	0·5000	1st experiment	0·5000.
	,,	2nd ,,	,,
	,,	3rd ,,	,,
	,,	4th ,,	,,
Tribasic phosphate of lime	0·3589	1st experiment	0·3600.
	,,	2nd ,,	,,
	,,	3rd ,,	,,
	,,	4th ,,	,,
Anhydrous pyrophosphate of soda	0·4179	1st experiment	0·4200.
	,,	2nd ,,	,,
	,,	3rd ,,	,,
	,,	4th ,,	,,

In all cases, however, bibasic salts must be converted into tribasic before the addition of the iron solution, which may be done by heating them with a little hydrochloric acid; and then the solution must be allowed to cool before the estimation is made, as heat alters the conditions and gives rise to a different compound of iron and phosphoric acid.

The method appears particularly useful for estimating the quantity of soluble and insoluble phosphates in superphosphate of lime as well as other manures, in the ashes of plants, and in all cases in which an expeditious determination of the phosphates is required.

Solubility of Mercury Precipitates in Alkaline Salts, by J. Attfield, *Demonstrator of Chemistry at St. Bartholomew's Hospital.*

The precipitates that are obtained on adding an alkali to the solution of a mercuric or a mercurous salt, are described in the ordinary text-books as being insoluble in an excess of the reagent. Practically, however, this is far from being the fact; the acid with which the mercury was combined forming an alkaline salt in which in nearly all cases the mercury precipitate is more or less

[1] Abridged from the *L. E. and D. Phil. Mag.*

soluble. Solution of the precipitate of course takes place more readily if the mercury solution contains free acid, or if another salt be present, the base of which is soluble in free alkali; a larger quantity of alkaline salt being in either case formed.

If, for example, to a tolerably strong solution of mercuric nitrate there be added a little nitric acid, or such a salt as nitrate of copper, and then solution of ammonia, no precipitate is obtained, or one which rapidly dissolves on adding excess of the ammonia. Indeed if the precipitate first formed be collected and washed, and then simply digested in solution of ammonia, it will be found to be soluble; a result one would scarcely have expected after reading the following in Gmelin's *Chemistry* (*Cav. Soc. Trans.*) vol. vi. p. 14: "Caustic ammonia and carbonate of ammonia form white precipitates with mercuric salts. This precipitate usually contains a compound of amide of mercury with undecomposed mercuric salt, and is insoluble in excess of ammonia." At p. 94, however, of the same volume, is found an apparent explanation of the matter. It seems that under the circumstances — circumstances that in class-teaching are not uncommon — a compound is formed containing one equivalent of mercuric amide with five equivalents of mercuric nitrate, and that this particular compound *is* soluble in excess of ammonia.

Briefly; it will be found on experiment that these mercuric-amido precipitates are all more or less soluble in solutions containing much nitrate, sulphate, chloride, or some other salts of ammonium. Mercuric arseniate and phosphate are similarly affected.

Salts of the fixed alkalies interfere with the formation of mercuric precipitates; but to a very much smaller extent than ammoniacal salts. A trace of mercuric oxide dissolves in large excess of strong caustic potash or soda, but a notable quantity dissolves in strong solutions of the salts of those bases. Mercuric iodide is sparingly soluble in water; the solubility is however considerably increased by the presence of alkaline salts.

Mercurous precipitates are all as soluble in ammoniacal salts as mercuric precipitates; and moreover are as soluble in the salts of the fixed alkalies as they are in those of ammonia. In most of these cases a decomposition of the mercurous compound occurs, mercuric salt being dissolved and metallic mercury left insoluble. Ordinary commercial calomel when agitated with a saturated solution of chloride of ammonium is largely dissolved, a small quantity only of metallic mercury remaining insoluble. Wittstein is quoted (*op. cit.* p. 56) as having found that "calomel is soluble for the most part in sulphate of ammonia, but very sparingly in the nitrate and succinate."

Mr. Spiller (*Qu. Journ. Chem. Soc.* vol. vi. p. 115) has remarked that alkaline citrates interfere with the precipitation of mercury.

No doubt the salts of the alkaline earths retard the formation of mercury precipitates. At p. 12 of the volume of Gmelin's *Handbook*, already referred to, it is stated that "chloride of magnesium and chloride of calcium when boiled in the state of concentrated solution with mercuric oxide give up to it a portion of their acid." In the *Pharm. Jour.* also (2nd series, vol. i. p. 194) Mr. Rogers notices that when calomel is agitated with lime water, mercury is taken up by the liquid.

In conclusion, it may be remarked that the above sources of loss in the preparation, detection or estimation of mercury compounds may be avoided to a considerable extent by using dilute solutions and by allowing the mixtures to stand for some time.

TECHNICAL CHEMISTRY.

Arsenical Paperhangings.

Much has already been written on this subject, nevertheless, it may be acceptable to some of your readers, to possess a short summary, by one practically acquainted with the various different kinds of papers of that description.

The arsenical green or arsenite of copper is a highly poisonous compound of arsenious acid and oxide of copper, with sometimes a portion of acetate of copper, and is commercially known as Scheele's or Schweinfurth green. It is an insoluble precipitate obtained by boiling solutions of arsenious acid or arsenites of potash or soda, with sulphate or acetate of copper. The washed precipitate is dried at a temperature of 212°F., a temperature unable to decompose or volatilise any of the arsenious acid of the compound. This dry insoluble precipitate is levigated with a glutinous vehicle such as gum, dextrine, &c. to render it applicable for printing; additions of chalk or other coloured media give the different shades of green. These colours when painted or printed on paper constitute the green arsenical papers in question, which for convenience sake we may divide into two classes, unsized and sized; as however flock-papers have become of considerable importance, it will be necessary to say a few words about their manufacture as well. Flock papers are covered with a thick uniform layer of variously coloured woollen fibres, which constitute the flock, and owe, like similar woollen materials, their colour to a process of dyeing, for which purpose a soluble colour and no insoluble precipitate is necessary. The green of the flock is perfectly harmless and free from arsenic; its manufacture is almost solely carried on in France, where, in all probability, an indigenous vegetable dye (*grains d'avignon* or French berries) enables the manufacturer to maintain this monopoly in preference to other countries.

Papers which contain this green flock over the whole surface may therefore be considered free from arsenical compounds. When this, however, this is only partly done and the paper intermixed with other colours and drawings, these latter have to be separately examined and placed in either of the two before-mentioned classes.

By *unsized* papers we mean such whose colours after being printed are simply allowed to dry without undergoing any further process or treatment; *sized* papers however, have in addition to this an extra coat of size or varnish over their colours, which protect them from easily rubbing off.

Since the theory of the spontaneous evaporation or volatilisation of the arsenic in the paint gave way to the more palpable mechanical agency of servants' brooms and dusters, we required neither aspirators nor microscopes to seek for its presence; arsenical dust can be collected by the ounce, and sheets of copper gauze and foil well covered with it. With the loss of this theory, the arsenic question assumes a more tangible and practical character, and enables us to find remedies or protection against their evil consequences. It is

evident that paints of a powdery and friable character, when thick and loosely laid on paper, will soon, by touch or rougher treatment, become detached and be mixed with the atmosphere, and should such an unsized paper still contain any flock, especially on a green coloured ground, the danger will naturally be increased. The simple arsenite of copper is a comparatively heavy substance, which when once loosened would soon fall to the ground, and subsequently be removed; the light floculent woollen material however will float in the air for some time, and when mixed with particles of arsenical paint will bring this dangerous body in continual contact with those whose more refined senses are keenly perceptive of its pernicious effect. But besides this really dangerous property, these flock papers are of a thick, spongy consistence, and require when fastened to the walls a considerable amount of paste and moisture, which for some time afterwards will give a room a disagreeable moist atmosphere, very liable to cause headache, a circumstance which naturally has led to the suspicion that the danger lay principally in the flock and not in the more hidden, but nevertheless, solely dangerous ingredient.

It would be therefore unwise to advocate an indiscriminate use of these green papers, but it is equally uncalled for to look at every green colour on our walls with fear or suspicion. Many may have suffered from living in rooms decorated with incomplete and inferior arsenical papers, but it is equally certain that still more have and still enjoy the best of health in rooms decorated with green papers of a better and more careful manufacture. A green arsenical colour well prepared with a sufficient amount of gummy matter, and not too thickly laid on the paper, and well sized over, so that a reasonable amount of friction with cloth or hand is unable to remove any colour, is a perfectly harmless ornament, which may be selected without fear. Should it contain any flock, it would be satisfactory to know that this flock is not fixed on a green arsenical ground, as an elevated rough surface is more liable to be detached than the plain smooth ground, and when loosened it would in all probability carry some of the green colour underneath with it. Lastly, in examining green papers for arsenic, we know with what diffidence hydrochloric acid and metallic copper tests must be confided, and how suspicious the bright yellow precipitate looks which HS produces in our acid liquor; neither is the presence of copper alone a sufficiently satisfactory evidence for arsenic in any green pigment. A more simple and safer mode of testing these papers consists in scraping a few grains of the suspected green colour off, introducing it into a dry test tube by means of a slip of paper, so as to keep the sides of the test glass clear. By closing its aperture and gently heating it in the gas flame the green powder soon becomes carbonised, and if arsenic is present this sublimes as arsenious acid perfectly distinct and visible above the residue. When cold the carbonised residue is removed, the test tube filled to about a quarter with distilled water, a drop or two of liquor potassæ added, and the mixture boiled. This solution is respectively tested with ammonio-nitrate of silver, or ammonio-sulphate of copper, when the characteristic yellow and green precipitates will further point to the nature of the directly obtained arsenical sublimate. It is evident that in the above process the arsenic can only be derived from the green colour of the paper, whose shade and amount of green will in most cases give us a sufficient estimate of the arsenic they contain.—*J. S.*

PHARMACY, TOXICOLOGY, &c.

Purification of Castor Oil.

It is well known that castor oil on being kept a long time undergoes some changes. It gets thick and becomes rancid, at the same time acquiring an acid taste, which remains in the throat some time after the oil has been swallowed. M. Parvesi, of Turin, has found an easy means of purifying this rancid oil. He mixes 1000 parts of the oil with 25 of animal charcoal, and 10 of calcined magnesia, and leaves them together for three days at a temperature of 68° to 78° F., often stirring or shaking the mixture. The oil is then filtered off, and is found to be limpid, colourless, odourless, without taste, and easily soluble in alcohol. It congeals too at a lower temperature than before, and is in that respect superior to the ordinary oil.

Preparation of Mercurial Ointment.

M. Delarue[1] in an article on *The Influence of North Wind on the Preparation of Mercurial Ointment*, says that a long experience has convinced him that the presence of water in the lard greatly interferes with the extinction of the mercury. He therefore specially prepares the lard by heating it over a quick fire to 125° or 130° C. to expel all the water. He then sets it aside for three days. When the ointment is prepared he first mixes the whole of the mercury with a third of the lard, and then gradually adds the remainder. Trituration for two hours will suffice to obtain an ointment presenting all the characters required.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, 15 March 1860.

Dr. Miller, *V.P. in the Chair.*

Mr. Hadow read a paper *On the Composition of the Platinid-cyanides*. He first adverted to the platino-cyanides, which are extremely stable salts having the general formula $MCy.PtCy$ or $MPtCy_2$. These salts are remarkable for the great beauty and variety of colours their crystals exhibit, while their solutions are colourless and transparent. Thus the platino-cyanide of magnesium is deposited from a colourless solution in large prisms of a deep red by transmitted light, but of a brilliant iridescent green and purple by reflected light. In endeavouring to prepare this salt by the method of Quadrat, namely, by evaporating together solutions of sulphate of magnesia and platino-cyanide of potassium and extracting with mixed alcohol and ether, the author by using alcohol alone, obtained in addition to the ordinary deep red salt one of a paler colour, and of a modified iridescence, which proved to be a double platino-cyanide of magnesium and potassium, $MgPtCy_2 + KPtCy_2 + 2HO + 5aq$. The platino-cyanides may be converted into the salts known as platinid-cyanides by the action of chlorine, bromine, nitric acid, &c. They are usually represented by the formula $M_2Pt_2Cy_5$, and are considered to result from the addition of 1 atom of cyanogen to 2 atoms of the platino-cyanide. These salts act like the ferrid-cyanides by exerting a powerful bleaching agency in presence of free alkali, and by liberating iodine from iodide of potassium. The acceptance of the above formula, however, renders it extremely difficult to account for the

[1] *Le Moniteur Scientifique*, 1 Mars 1860.

formation of the salts by the action of chlorine, &c. or to account for their reduction from alkaline solutions to the state of platino-cyanides without the production of cyanide of potassium. Mr. Hadow's analysis of the platinid-cyanides showed, in the first place, that the proportions of cyanogen, platinum, and basylous metal, were the same as in the platino-cyanides; and in the second place, that the platinid-cyanides contained chlorine, bromine, or peroxide of nitrogen, according to the reagent used in producing them. The determination of the chlorine directly was unsatisfactory, but the author effected the estimation very readily by ascertaining with a standard solution of permanganate of potash what quantity of chlorine was required to convert the platinid-cyanide into the ultimate product of the action of chlorine upon the platino-cyanide, namely, the perchloro-platino-cyanide $KPtCy_2Cl$. In this way the so-called platinid-cyanide was found to have the composition $6(KPtCy_3)Cl$. This salt, when acted upon with a solution of zinc, broke up into a platino-cyanide, which was precipitated, and a perchloro-platino-cyanide which remained in solution. Conversely, by adding 1 proportion of perchloro-platino-cyanide to 5 proportions of platino-cyanide, the so-called platinid-cyanide, or, as the author termed it, the chloro-platino-cyanide was deposited in crystals; so that it appears to be really a double salt $5\,KPtCy_3 + KPtCy_2Cl$. The compounds produced by the action of bromine and nitric acid upon the platino-cyanide were believed to have a similar constitution. No iodine compound has been produced. Analogous compounds, however, containing the radical SO_4 in the place of chlorine, were formed by adding peroxide of lead to solutions of the platino-cyanides, acidulated with sulphuric acid.

Mr. Morreland read a paper *On a new Ammonio-chrome Compound*. The salt was prepared by adding finely powdered bichromate of potash to fused sulphocyanide of ammonium. A brisk reaction soon took place, and the residue having been washed with water was dissolved in alcohol, from which the new compound crystallised out in forms of the regular system. The composition of the salt was represented by the formula $Cr_2Csy_3.2NH_4O$. Heated in a closed tube it gave off sulphide of ammonium with other products, and left a residue of sulphide of chromium.

Mr. Hooker read a paper *On the Analysis of a Water from the Superficial Strata of the London Basin*. The water yielded 183·7 grains of residue in a gallon. It was remarkable for the large amount of nitric acid it contained, namely, 33·2 grains in a gallon. The nitric acid was estimated by Nesbit's process, that is to say it was reduced to the state of ammonia by means of nascent hydrogen generated from zinc and sulphuric acid, and the ammonia thus produced evolved and neutralised by a test acid.

The anniversary meeting for the election of officers, report of council, &c. will take place on Friday, March 30, at 8 P.M.

SOUTH KENSINGTON MUSEUM, 14 *March* 1860.

On the Flavour of Food, by Ed. Lankester, *M.D., F.R.S.*

CONDIMENTS AND SPICES.

A passage occurs in the life of a practical philosopher which is well known to a large number of readers in England, and which so well illustrates the subject of the evening that I will read it.

"'Weal pie,' said Mr. Weller, soliloquising, as he arranged the eatables on the grass; 'Wery good thing is a weal pie, when you know the lady as made it, and is quite sure it an't kittens; and arter all though where's the odds, when they're so like weal that the wery piemen themselves don't know the difference?'

"'Don't they, Sam?' said Mr. Pickwick.

"'Not they, sir,' replied Mr. Weller, touching his hat. 'I lodged in the same house with a pieman once, sir, and a wery nice man he was — reg'lar clever chap too — make pies out o'anything, he could. 'What a number o' cats you keep, Mr. Brooks,' says I, when I'd got intimate with him. 'Ah,' says he, 'I do — a good many,' says he. 'You must be wery fond o' cats,' says I. 'Other people is,' says he, a winkin' at me; 'they an't in season till the winter though,' says he. 'Not in season!' says I. 'No,' says he; 'fruits is in, cats is out.' 'Why what do you mean?' says I. 'Mean!' says he; 'that I'll never be a party to the combination o' the butchers to keep up the prices o' meat,' says he. 'Mr. Weller, says he, squeezing my hand wery hard, and vispering in my ear; 'don't mention this here agin, but *its the seasonin' as does it*. They're all made o' them noble animals,' says he, a pointin' to a wery nice little tabby kitten; 'and I seasons 'em for beefsteak, weal, or kidney, 'cordin' to the demand; and more than that,' says he, 'I can make a weal a beefsteak, or a beefsteak a kidney, or any on 'em a mutton at a minute's notice, just as the market changes and appetites wary!'"

Well that is the text of my lecture to night, "*it's the seasonin' as does it*," and you know that condiments and spices are the seasoning with which we make our food pleasant; and, after all, if you consider what makes the difference between the various kinds of food, you will find that Mr. Brooks's philosophy is the correct one. It is the taste and flavour that make the different varieties of food. Now the nervous system is as much formed for the appreciation of these tastes and flavours, as the ear is for sound, and there is as much relation between sounds as addressed to the ear, and colour as addressed to the eye, as there is between different flavours as addressed to the palate. The man who appreciates sound and colour best, is also the most capable of appreciating the taste and flavour of a meal; and we shall find that as intense colours overcome faint colours, as intense sounds overcome sounds which are not so loud, so intense tastes and flavours overcome other tastes and flavours; and just as we would for a concert arrange the music with regard to the variation and selection of the different sounds, so we should for a meal arrange the variation and selection of our tastes and flavours. The same Creator who created the ear or the eye, created the taste, in order that we might appreciate the charming things around us.

Now I must in the first place draw attention to the tongue. The tongue alone, however, is not concerned in this appreciation of tastes and flavour, for we find that the nose is jointly occupied with it; for there are certain flavours that we should hardly taste at all had we no noses, and there are certain of our foods which altogether address themselves to the sense of smell. Take cinnamon, nutmegs, or cloves, for instance; if we put some of these into our mouth and close the nose, we can hardly appreciate the flavour; so it is evident that we frequently use the sense of smell in the exercise of the organ of taste. It is a curious fact that those nerves which give the sense of taste or flavour are the nerves of common sensibility, that is to say, those by which we feel the *touch* of any object upon the external surface of our bodies by friction or otherwise. When considering the fact which I have just mentioned, that some things are not really tasted at all unless they are smelled, some persons have supposed that there is no real function of taste, but that what we say we taste, we either smell or feel, or that the sensation of taste is compounded of both. The better way to test that is to apply something to a different part of the body, such as quinine or sugar to the leg, and you will find that they produce no impression of taste or flavour in the leg; although if you put quinine upon the tongue, you will have an excessively bitter taste, and with the sugar—sugar of lead and other substances—a sweet taste, and a taste of salt with salt, sulphate of soda and a number of other things; so that we can thus prove that there are certain things which we really taste. Now we will call these substances which are tasted *sapours*, in opposition to those which are called odours.

Passing on from the nerve of taste I would just say with regard to the nose that it is the organ of smell, and that it has a distinct nerve of smell. Now there are certain things which address the organ of smell which are not taken up into the mouth. Thus we have a variety of gases and things which we call scents, odours, perfumes, smells and

stinks, which address themselves to these nerves. We find that this function is developed greatly in the lower animals, and even among the wild races of men this function of smells is very much greater than among cultivated and civilised races; and the fact of man having a sense to guide him in taste and smell is of importance where our intelligence and sense tells us what is good for us, as sometimes happens in the case of persons in illness judging as to what is good for them better than the doctor; doctors have sometimes yielded to a patient's wish for some particular food in consequence of this instinctive desire, and the patient has been very much better for it. As instances of the use by the lower animals especially of the sense of smell, I may say that they will instinctively reject food which is poisonous, however carefully you may wrap it up, even when pressed by much hunger. Monkeys, cats, dogs, and animals of the higher class will pertinaciously reject it, their determination arising from the sense of smell. It is not only from the olfactory nerve that provision is made to guard against the destruction of the animal; a man may be sometimes placed under circumstances in which he will be exposed to carbonic acid, chlorine, or a variety of gases which if taken into the system would destroy him; he has then, besides the sense of smell to detect these gases, the fifth nerves which produce the sensation which we call sneezing, which are titillated by various powders and gases which would act injuriously if they went into the lungs. This act of sneezing is the act of throwing away or getting rid of that which if a man got into his lungs would injure him. When a man sneezes he draws back, in cases where if he went forwards he would soon repent, and perhaps cause very serious consequences. The taste has reference to food, the smell has reference to that which probably may be good for food, while the nerves distributed with the olfactory nerves have reference to the gases.

I now pass on to consider, in the second place, the nature of the various kinds of sapours and odours which we find in our food. To a thoughtful mind, there are many ways of classifying these, but I may speak of them as agreeable and disagreeable odours and flavours, addressing both the organs of taste and smell. In the first place, we have a number of agreeable odours, and these odours may or may not accompany our various kinds of food. I will just allude to some of these. I have here a number of those which are occasionally used to put into food, and occasionally to put into perfumes: these are agreeable odours. Then, again, we have another set, which are disagreeable, arising from the mineral, the vegetable, or the animal world. Substances of the vegetable and animal worlds in decomposing produce sulphuretted hydrogen, which is a disagreeably offensive odour, and injurious to health. I will glance at the fact that the carburetted hydrogen in the gas which we burn gives out a disagreeable odour. Sometimes these disgusting odours, by custom and habit, become agreeable, and sometimes, in the same way, disgusting food, by custom and habit, becomes agreeable food: high game and things of that sort are not generally rejected, because we are accustomed to the flavour. There is a story told of a king of Prussia being confined in a prison a long way from the sea-shore, where they never could get oysters until they were what is called a little gone; he being fond of oysters became accustomed to these, and afterwards never could endure the presence of fresh oysters. This will illustrate a curious fact which we shall meet with, that some odours, naturally disagreeable, become agreeable by habit. You will find it very difficult to make children take things which, when they grow up, they acquire a taste for — olives, for instance, or tobacco. It is to those tastes and flavours which are most commonly employed in food to which I would draw attention more particularly, and I will say that those tastes and flavours are all more or less composed of the same elements.

When speaking of food on a former occasion, I said that the four constituents composing our food were carbon, hydrogen, nitrogen, and oxygen. These are the very elements which arranged and rearranged in a variety of ways form the flavours which after all distinguish one food from another. Of these various tastes and flavours there are a series which we call by the name of essential oils, and another which we may refer to as a class of bodies called ethers; but before speaking of essential oils or ethers particularly, I will call attention to the production of common ether. I have here some which you will recognise as having that smell which is so refreshing to persons who have a difficulty in breathing; you will soon smell it in the room if I take the cork out. Now that ether is made from alcohol. Alcohol is the result of decomposition of sugar. If we take grape sugar we find it composed of 12 parts of oxygen, 12 of hydrogen, and 12 of carbon; and alcohol, which is the substance at the foundation of all our odours, is composed of 4 of carbon, 6 hydrogen, and 2 oxygen, arranged as 4 of carbon, 5 hydrogen, 1 of oxygen, and 1 atom of water. Now if we take away from it the water we have ether left, which is an oxide of the substance ethyl, composed of 4 carbon and 5 hydrogen, the same elements that are in coal gas. The whole of these scents and odours arise from componds of carbon and hydrogen. This substance ether, which is an oxide of ethyl, will combine with acids, so that we have sulphates of the oxide of ethyl, tartrates and citrates of the oxide of ethyl, &c. A distinguished French chemist has discovered that one compound of oxygen and hydrogen and carbon, combining with chlorine, with iodine, and with nitrogen, has been capable of producing 1020 different compounds; and there are thousands and tens of thousands, nay hundreds of thousands, of compounds which may be similarly produced, and which give flavours and odours, and scents and peculiarities, in thousands of directions which we know of, and in hundreds and thousands of directions which we know nothing of, and this is the direction in which organic chemistry is going in the present day. What then is their action on the system? I will take any of these upon this table: there is orange flower, that contains one of these compounds, then the melon, that contains another of these ethers, and I might take nutmeg, quince, pear, or apple, or any other fruit, and I should find that they all contained essential oils, which are volatile bodies — compounds of carbon and hydrogen — arising from these substances and giving their taste and flavour to the tongue or nose. It is one of the most curious features in the history of modern chemistry that not only has the chemist been able to show the nature of these compounds by pulling them apart, but he has begun to find out the way to put them together again; and the chemist can now produce in his laboratory what is ordinarily produced by nature in the laboratory of the plant or fruit. One of the first things that was formed in this way was the oil of bitter almonds. You know that bitter almonds contain an oil which may be extracted from them, and has a very pleasant flavour or scent. It is used in custards, puddings, cakes, and in a variety of other ways; and this essence obtained from peach kernels, and these other scents, are also used for various similar purposes. There are two or three substances ordinarily sold in the present day for oil of bitter almonds which are manufactured from other matters. I have here a substance called benzol, which is a compound of carbon 10 and hydrogen 6, instead of 4 and 5. Now this benzol can be formed from other substances just in the same way as the chemist can form the ether, by decomposing certain compounds and leaving the carbon and hydrogen in the above proportion; and this is sold under the name of benzol, benzine, and benzoline, and is probably known by some persons present on account of its being used for cleaning gloves, it having a greater solvent power in relation to dirt than ether or alcohol.

This benzol is obtained from coal tar which is a most valuable substance, and although it is rejected at the gas factories, it is likely to become of most essential service to man in the manufacture of very many things. By adding nitric acid to benzol we obtain this nitro-benzol, or artificial oil of bitter almonds. There is another substance, hippuric

acid, extracted from the drainage of our stables which, when submitted to the action of heat, can be made into nitro-benzol, so that, as I have said in a former lecture, there is no such thing as real dirt, for dirt is merely matter not in its proper place; although used by man in a thousand ways, the elements are still pure, and only have to be again reunited. Hippuric acid is obtained from the stables, and its product is introduced into the most delicate soap and applied to our faces. And this is only one of a series of oils. There is a substance for which we in England have long been celebrated — pear oil — in the manufacture of which no pears are used. We take amyl, which is got from potatoes; it is composed of $C_{10}H_{11}$, and when united with common vinegar or acetic acid, we get a substance which cannot be distinguished from the smell of the jargonelle pear. Here is some of this scent which is sold in the shops, and for the manufacture of which we have been celebrated for upwards of six years. It is out of this manufactured pear oil that this jar of cheap lozenges is made, which are sold in the shops at a penny an ounce. The yellow drops are made of another oil — pine-apple oil — introduced into a variety of forms of confectionary — and here we have our old friend ether coming in again. You have all smelt rancid butter which has been long kept; distil that rancid butter and you will obtain butyric acid, mix that with this ether, and it becomes a pine-apple flavour. Now nature has done the same thing; there has been a manufacture of butyric acid and ethyl going on within that beautiful fruit which we call pine-apple, and here you will taste the essential principles which give the taste to the pine-apples. Then here is the oil of apples. There is an acid in the substance known by the name of valerian, which has an exceedingly unpleasant smell. There are things which for a moment are exceedingly pleasant, but by taking too much they become exceedingly unpleasant. Valerian is of that kind, containing valerianic acid, and that combined with the oxide of amyl constitutes what we know by the name of apple oil, which is used in the apple confectionary. The pleasant taste of apple is produced in that way. Now this oxide of amyl can be got from potatoes, coal tar, and other substances, so that there is no difficulty in making these oils, and so many of them have been made that we shall soon have no difficulty in procuring them, without having recourse to the vegetable kingdom. That these things are composed of carbon and hydrogen I can show you in a variety of ways. By their inflammability, for instance. I have here a little instrument called a spirit-lamp. Here I have some lavender water which you see is burning away very rapidly, and I have here some papers which have been dipped into some of these oils, which speedily disseminate their odours when ignited. You will smell them about the room in a few minutes.

I must now leave this subject and say a word with regard to the action of these oils on the system. When taken into the stomach they act upon the nervous system as well as in the regions of taste or smell, and produce an effect upon the stomach, causing the secretion of a large quantity of gastric acid, and causing digestion to go on better. We instinctively add to meat stews Cayenne pepper and things of that kind, which act as stimulants to the stomach — they act as alcohol and stimulate the nervous system. Persons can get tipsy upon oil of cinnamon and oil of cloves just as they can upon hydrated oxide of ethyl. I have here a wonderful display of *liqueurs* sent down by Messrs. Fortnum and Mason of Piccadilly, liqueurs of France, of Germany, of Sweden, and Norway, and here is one of those which has become celebrated on account of its killing so many Frenchmen lately. It is called absinthe, and is prepared from wormwood. This wormwood, which I now hold in my hand, contains a volatile oil which acts not only as a stimulant to the stomach, but also has a narcotic effect upon the nervous system; and a distinguished French chemist has just discovered that this wormwood contains seventeen deadly principles, any one of which would kill an individual who would venture to ake it. Absinthe contains as much as 20 per cent. of alcohol, and if a Frenchman drank as much absinthe as he did brandy he would soon kill himself. Then, passing on from this substance, I would just speak of the classification of these sapours and odours. I have found considerable difficulty in this, arising from the various terms that are given to them; but I have arranged them under the heads of condiments, spices, fruit flavours, and bouquets, and to these I would now draw attention.

Now what is a condiment? Well I have not been able to get a satisfactory answer, but I have thought that these volatile oils, or ethers, or whatever you may call them, which can be taken with salt are condiments, and those on the other hand that can be eaten with sugar are spices. I have put among the *condiments* as being flavours agreeable with salt — garlic, leek, onions, mustard, pepper, Cayenne pepper, capers, pickles, parsley, celery, coriander, thyme, sage, mint, fennel, mushrooms, morels, truffles. Now looking at these condiments you will find that they all of them contain different kinds of essences, oils or ethers, or whatever you like to call them, and some of them so distinct as to admit of classification. Thus garlick, leek, onions, and assafœtida are condiments. Persons fond of onions will get from onions to leek, from leek to garlic, and from garlic to assafœtida, and so it is in the City, if you go to a chop-house, and ask for your steak to have a little higher flavour, they take the plate, rub a little assafœtida on it and put it before you: you do not know what it is, but find it agreeable. Now how is this? If we take a substance from the region of our pleasant scents and odours, and add to these bases — these hydrocarbons — instead of oxygen, a little sulphur, then you will get things with sulphur smells, — onions, leeks, water-cresses, cabbage. When cabbage is boiled there is the sulphur smell which ascends to the drawing-room, and it is: "Pray shut the kitchen door: you are boiling cabbages." Now in the case of garlic, leeks, and assafœtida, we have a substance called allyl, but in the case of mustard and water-cresses, and those things, we have another substance in addition to the sulphur, carbon, and nitrogen, and that is cyanogen, which when it is united with hydrogen forms hydrocyanic acid, one drop of which kills a man. You see what a fearful thing chemistry is. These substances are all connected one with another, up and down a ladder as it were, in their combinations, but are yet distinct.

Now I come to the peppers, and here our chemistry a little fails us. Peppers are not always the same thing; there is long pepper belonging to one family, and Cayenne to another family, and other peppers belonging to other families; so that pepper is not a term that we can use botanically or chemically.

Here I am reminded of a series of very pretty little bottles which contain condiments and spices, which have been prepared in such a way that about a tenth part is equivalent to the whole substance in its natural condition. They are prepared in France, and as far as I have considered them they are likely to be useful to those persons who desire to study the flavours of taste or smell as they would the sounds of music. I will therefore recommend these soluble spices to the epicure and to those who have the wish to study these things. Now there are two or three other things which have to do with the preparation of condiments, but I must not now dwell upon them. For instance, we may take onions, which contain as an essential oil sulphide of allyl, and let them soak in vinegar, — here I have some chalot vinegar prepared in this way with pure fermented vinegar — this is another way of adding these condiments to our food, and there can be no doubt that vinegar has certain effects on our food by dissolving some things which water and acids would not dissolve. Vinegar, however, like alcohol, may be constantly abused. It acts upon the coats of the stomach so as to prevent their proper healthy action, and instances have been known of young ladies who, wishing to grow thin, have drunk such large quantities of vinegar that they have brought themselves into consumption. Here, again, are other substances which yield a pecular flavour. I mean these mushrooms, which start up in every direction after a

shower in the spring and autumn, and which are so valuable not as articles for diet but for flavour, and which flavour depends upon fungic acid. All these fungi can be made available for condiments. In Russia, and many parts of France and Italy, large quantities of them are consumed, and it is a curious fact, showing how little we know of the nature of these bodies, that the very ones that we think can alone be eaten with impunity cannot be purchased in the Roman markets, the inspector stopping that sort. Morels and truffles are also condiments. The mushrooms may be kept dried and powdered for any length of time, and added as pungents to articles of food.

But I must now pass on to the spices or flavours mostly used with sugar, such as ginger, allspice, cloves, nutmegs and mace, cinnamon, carraways, bay, angelica; and will just say that cinnamon may be taken as the type. It is indebted for its flavour to oil of cinnamon, which may be dissolved out by means of alcohol, and constitutes essence of cinnamon. Oil of cinnamon is also found in the plants *lauraceæ*, which not only yields cinnamon but cassia, which is employed to adulterate cinnamon itself, or is a fraudulent substitute for the essence. Camphor is yielded by a plant called *laureas camphora*. Cloves belong to an order to which our common myrtle belongs, *cefreons rusticus*. Pimento is the unripened fruit of the *metus pimento*, and the oils resemble those which we got from the other order, lauraceæ. Then we have nutmeg oil. In the covering of the nutmeg we have a substance which is called mace, which contains a slightly different oil from the oil of nutmeg itself. Then there are several others which may be classed as spices, all of them containing volatile oils.

Now I have distinguished a certain number of the things which come under the name of fruit flavours, or flavours found in the fruits of plants, not usually called condiments or spices, such as bitter almonds, vanilla, pear, pine apple, raspberry, strawberry, melon, orange and lemon peel, citric, tartaric, malic, and oxalic acids; many of these have been imitated artificially. Thus we find the apple flavour, the pear, and the pine-apple, have all been imitated successfully; but there are others which have not; for instance, the oils contained in the orange peel or the lemon peel. If you look at the outside of the peel of an orange or a lemon you will find a number of vesicles containing the essential oil, and when this is mixed with spirit it is called essence of lemon, essence of orange, and so on. These things which are candied are not eaten because of the peel but of the flavour contained in it. Here I have the angelica, which no one would think of eating alone; but when it is candied the consequence is that the angelica flavour is given to the sugar. Here I have the melon candied, and the cashew flavour given to the sugar. Here is some citric acid which is found in the whole of the fruits belonging to the orange tribe. This citric acid can be extracted in a crystalline form from lemons and oranges. And here is tartaric acid obtained from the grape, which has a very different property from the citric acid. When I put some liquor potassæ into the tartaric acid I obtain a salt called cream of tartar. When wine is made from grape we get a precipitate of tartar; but when it is made from oranges and lemons we obtain no precipitate, it remains in the wine. Here also is another acid, oxalic acid, used for cleaning boot tops and things of that sort, and every now and then it is taken by mistake for epsom salts. It is contained in wood sorel and rhubarb, and this rhubarb is eaten on account of the oxalic acid which it contains; and that is the reason why we eat rhubarb tart whilst we are waiting for the gooseberries and currants. These then are the fruit flavours. There are two or three other flavours which I should like to have mentioned: I am reminded of the vanilla flavour obtained from fruits, which would scent the whole room, and which is put into chocolate and a variety of articles of diet on account of its delicious flavour.

I have put down in the prospectus as a subject for this evening, the bouquets of wines, spirits, and liqueurs. You know what the value of wine is. Here is some old tokay, some wine of Cyprus, some old sack; and here are wines of unmeasured price. And why? If you look upstairs you will see their analyses. They contain water and sugar and acid, as all other wines do; why then do they obtain such prices? It is the *seasoning that is in them — the œnanthic ether*, which is capable of being split up into many varieties of compounds; and then there are obtained those fine flavours which can now only come out of old crusted ports, or which can only be got out of the burgundies or clarets; and there are flavours that can only come out of one hill on the Rhine—the Johannisberg.

If we take nutmeg or any of these spices and distil them with spirit, we obtain liqueurs. Some of those liqueurs are mixed with flakes of silver, in order to imitate a silver beverage, for common people, I suppose; and here they are mixed with flakes of gold for another class of people. I might speak of the flavour of gin with our common juniper berries; I might speak of brandy flavours obtained from common pitch or benzol; I might speak of whisky with an artificial flavour, and rum containing this butyric ether, and it would all tend to show you that that great philosopher Mr. Brooks was right when he said "*Its the seasonin' as does it.*"

SOCIETY OF ARTS, 14 *March* 1860.

SIR T. PHILLIPS, *F.G.S.* (*Chairman of Council*), *in the Chair.*

A PAPER, upon *The Art-treatment of Granitic Surfaces*, was read at this meeting of the society by Mr. JOHN BELL, from which, although perhaps somewhat out of the province of this journal, we will cull a few paragraphs. The lecturer commenced by pointing out the chief characteristics of granite, and the style of art most suited to that material, the enduring nature of which has enabled our *savans* to decipher so much of the history of Ancient Egypt and Assyria. The art models of the Egyptians were generally taken from the vegetable world, the "Sacred Nile" supplying him with plants and flowers in abundance, his principal types, however, being the *papyrus* and *lotus*. *Incised relievo* was the style most generally adopted in the land of obelisks and pyramids, a method possessing many advantages over the ordinary or *projecting* relief, and one that Mr. Bell thought should be employed more often at the present day. On this point he says:—

"Now, doubtless this mode was recommended in a degree to the Egyptians by its convenience as well as by the simplicity of its workmanship. For instance, the faces of an obelisk, or tomb, or temple, might be hewn down quite plain without any previous arrangement of projections left for the sculpture, the very subject of which might be left for after-consideration, as was evidently occasionally the case in Egyptian works.

"The ease and convenience that thus, in this respect, attached to the method then, would, of course, equally attach to it now. Take, for instance, the large granite forms of a bridge. These might be hewn with the greatest breadth and simplicity, and yet, afterwards, either before or after erection, the blocks which compose it might receive the decorative enhancement of incised relievos.

"One remarkable art quality also must not be overlooked in this incised method of relievo, viz. that while it finely decorates a surface it does not disturb its breadth, enough of the true original surface always remaining to assert that. Nor does it take away from the impression of solidity, but rather the contrary. Also, it does not injure the profile. You may recognise at once how the effect of an obelisk, for an instance, would be destroyed by any projecting relievo on its faces; how, in that case its grace and character would be lost at once, while, on the other, hand, any degree of incised enrichment is applicable to its faces, without any disturbance of the original contour. This would suggest that this mode is applicable also to columns of elegant proportions.

"Another advantage of this style of work is its enduring character, especially when worked in granite. There is nothing to knock off. In fact, it excels in endurance the other styles of relievo as much as the material excels other stone, as is illustrated by the endurance of various Egyptian works of ancient time, in which some of this incised relievo has stood exposed to the atmosphere for more than 3,000 years, without being materially injured."

With the principal sources of the granites used in this country, and the usual modes of working the stone, our readers are probably acquainted, but one more quotation on the subject of quarrying, may not be uninteresting:—

"In Egypt the blocks are said to have been greatly wrought on three sides in their native bed; the stone in front, above, below, and at each end, having been worked away, so as to leave them projecting, and attached only by one side to the rock. Then the process was also to cut, between it and the rock, holes at intervals. Into these holes were driven, quite tight, very dry small billets of wood, exactly fitting them, which, afterwards, being amply and continuously supplied with water, swelled by absorption, and burst off the block. This mode was formerly used in some of our own quarries.

"In India, a long block was in a similar way fashioned horizontally on its native bed, at last, in like manner, hanging to the side of it. But this was detached by a different process, the aid of fire being called in as well as water; as thus:—On the top surface, between the obelisk and the rock, a long deep groove was chiselled extending the whole length. This was kept full of fire — of live embers — at a great heat for some days, when all at once were these swept out and cold water poured in the whole length of the groove, when the sudden contraction split off the mass neatly from end to end.

"In Russia, a still different method was applied—that of frost, which was so ready at hand. When the huge columns for St. Isaac's Church had been similarly wrought in their native bed, holes were made all along their attachments, and filled with water, which, expanding in freezing, burst off the block. So you see that there are several ways in which this apparently difficult process may be simply effected. Practically, however, in the British quarries, when a large block is pretty near separation, and is left for a night, it frequently detaches itself, owing also, as is supposed, to some effect of change of temperature."

The suitability of granite for our public drinking-fountains was next discoursed on by Mr. Bell, who also dwelt upon the propriety of taking many specimens of British flowers and plants as art-models, naming, specially, the white and yellow water lilies (*Nymphæa alba, and N. lutea*), various ferns,—the tiny myosotis and the "lily of the vale," all beautiful in themselves, and capable of great development when employed as types for extended decoration.

The discussion ensuing upon the paper we have thus briefly noticed, drifted immediately, far away from art, into the less poetical considerations of the geological origin of granite, and the cost of working it. The meeting terminated its proceedings by an inspection of the various specimens, drawings, &c. exhibited, and by a vote of thanks to the author.

NOTICES OF BOOKS, PATENTS, &c.

1. *On the Sewage of Towns as it affects British Agriculture, by* Mr. Alderman Mechi.
2. *On the application of Town Sewage to a large Agricultural Area, comparing its Strength and Dilution with the ordinary Farm Manurial Resources, &c. &c. by* Mr. Alderman Mechi. (*Read at the Society of Arts.*)
3. *A Lecture on Sewerage, Delivered at Oxford, by* C. Daubeny, *M.D., F.R.S., Professor of Rural Economy.*

Unfortunately for readers and reviewers, the literature of London sewage, if we may so call it, offers but little that is novel. The authors all enlarge on the sin of wasting it, all insist on its immense value, only varying in their estimate by a few hundreds of thousands of pounds; almost all are agreed that the only way of utilising it is to employ it for the purpose of irrigation, and all make use of the same illustrations of the immense benefits derived from its use. Of the worth we imagine there cannot be two opinions. Dr. Hofmann some years ago likened it to the gold in sands of the Rhine — "its aggregate value must be immense, but no company has ever succeeded in raising the treasure." Mr. Austin, in his *Report on the means of Deodorizing and Utilizing the Sewage of Towns*, 1857, says that the minimum value of the sewage is represented by six shillings per head of the population per annum. "This looks," he adds, "a small sum in itself: let us see what it means in reality. It means 3000*l.* per annum for every 10,000 of the population. *It means an average annual rate of upwards of eighteen pence in the pound!* And the difference between this sum and the actual cost of getting this manure on the land means the amount of *direct* money loss from permitting this matter to pollute our rivers and injure our health." The money value, calculated from a long series of analyses by Messrs. Hofmann and Witt, was represented as much higher than this. They estimated it in fact at 1,385,540*l.* per annum. Mr. Mechi thinks it is worth 2,000,000*l.*

But the great question for our consideration is — How are these sums to be realised? On this it must be confessed we have not yet received much enlightenment. The report of Messrs. Hofmann and Witt was almost entirely negative. They had no hesitation in stating their conviction that the problem of recovering the valuable constituents of sewage, remains altogether unsolved; and they had only very faint hopes that the progress of chemical discovery would supply the means of so doing. They pressed the claims of the irrigation scheme, not because they were sanguine of its success, but because, of the numerous propositions which had been made for the profitable disposal of London sewage, it appeared to be the only one which deserved seriously to be entertained. Mr. Austin is in favour of a mixed system of separating the solid matter by a rough sort of filtration, to form cheap solid manure, and using the liquid part only for irrigating grass lands.

But before Mr. Austin's Report was published a government commission had been appointed "to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses." A committee of five of these gentlemen visited and inspected all the sewage works in operation at the time (1857); a deputation made a trip to Milan, and in the following year they issued a "Preliminary Report." Two years have elapsed since the date of that Preliminary Report, and nothing more has yet been heard of the commission. Whether it is still sitting we do not know, nor is it, we imagine, of very much importance. There is nothing in the Preliminary Report which can lead us to hope that the subject will receive any great amount of elucidation at the hands of the commission. It merely repeated Mr. Austin's recommendation of a mixed system of precipitating the solid matters and using the liquid for irrigation, as circumstances, levels, localities, markets, &c. may render advisable.

It is in this state of the question that Mr. Mechi comes forward to support a gigantic scheme for distributing the sewage of London over a large space of country by carrying mains along the public roads, so that farmers shall only have to attach pipes to carry it all over their land. He proposes to raise a company with a capital of two millions, which shall construct the works and lay down the mains, and then distribute the sewage at the charge of one penny per ton within a radius of thirty miles! By an easy calculation Mr. Mechi arrives at the conclusion that the greater part of that penny would be profit on the undertaking. It does not lie exactly within our province, or we might point out to Mr. Mechi that within an area of thirty miles there are plenty of towns which might compete with London in the supply of

their own neighbourhood, and some other circumstances which might interfere with his calculations.

The indisposition of farmers in general to make use of the sewage he is perfectly aware of, and the paper read at the Society of Arts was intended "to rebut certain objections raised, and to dispel erroneous opinions that exist on this question." The answer to the first objection — that sewage is too much diluted to be beneficial, will show Mr. Mechi's way of answering objections. "The farmer's principal source of manure," he says, "is his live stock." He then goes on to show that the farmer has something less than two sheep per acre as a source of animal manure. Two sheep per acre would be equal in manurial results to two inhabitants of a town.

"Now let us see whether this manure of two sheep per acre gets more or less dilution than the excrements of two human beings residing in towns. The manure of two sheep, which is nearly all fluid (the dry matter being only $\frac{1}{18}$th), is spread over one acre of land. Taking the average of the kingdom the rain fall on this acre will be about 26 inches per annum, or 2626 tons. Thus the manure of each sheep is diluted with 1363 tons of water: but the excrement of each resident in towns only receives as follows:

Annually, as water supply . . .	30 tons
„ rain fall	50 „
	80 „

Thus proving unmistakeably that the much abused town sewage is in reality sixteen times less diluted, and consequently sixteen times stronger than that on which the farmers of England depend for the production of their crops."

To our minds Mr. Mechi has proved "unmistakeably," that when the diluted sewage of one individual is distributed over the acre, it gets sixteen times further diluted by the rain fall, just as the manure of each sheep does; or that the excrement of an individual when applied in the way Mr. Mechi recommends, gets diluted with 1443 tons of water.

It is in some such way as the above, we fear, that Mr. Mechi prepares the balance sheets which so confound farmers and puzzle accountants. In his published lecture he says that for the last six years his gain *as landlord and tenant* has been nearly 700*l.* per annum on his little farm of 170 acres. This looks an extraordinary result; but it is commonly said that Mr. Mechi, "*as landlord and tenant*" has *sunk* some 20,000*l.* on this little farm of 170 acres, for which sum 700*l.* per annum is poor interest for capital, to say nothing about profits on working the farm.

We have left ourselves scarcely space to notice Dr. Daubeny's cautious and thoughtful lecture, nor further to allude to the chemical part of the subject, than once more to press it earnestly on the attention of all practical chemists. "There is good ground for believing," say the government commissioners, "that the methods yet proposed for dealing with sewage are not the best that can be devised, and that further investigation will probably result in the discovery of processes more thoroughly equal to the suppression of the nuisance, and at the same time calculated to give more valuable products." In this belief we cannot help joining, and therefore strongly recommend the consideration of the subject to every chemist who is anxious for fame and fortune.

Treating Ores to obtain Metallic Oxides for Dyeing, Printing, and Painting. F. W. Emerson.

This patent was briefly alluded to in our last number; we shall now offer a few remarks upon it. We confess we should not take it up so much in detail, were it not that it has excited a great deal of attention, more especially among theoretical chemists who have long considered tungsten as belonging to those groups of metals which, like thorium vanadium, tellurium, and many others, are of extreme interest as regards their reactions and general properties, but apparently too rare to be made available in the arts. Tungsten has been looked upon by chemists for some time past as likely ere long to be removed from this reproach, and efforts have been made by several skilful chemists to apply the comparatively large quantities which are now being discovered to practical uses. Tungstate of soda has already been used as a mordant, and for the purpose of rendering fabrics non-inflammable; Mr. Emerson's patent is, more especially, for procuring colours for dyeing, printing, and painting.

The first thing to which his patent calls attention, and to which a chemist's notice would be attracted, whether placed first or last in the patent, is what the patentee considers a new metal, and accordingly, exercising the privilege of discoverers, gives to it the unfortunate name of chrolithineum. We say unfortunate name, because it is not only the longest name upon the list of metals, but the ugliest. We shall presently see the evidence upon which the existence of this new metal is based. Here are three points claimed in the invention:—

"It consists, firstly, in the separation of a metallic substance, which I believe to be entirely new, and which I propose to call chrolithineum, from the so-called ores of tungsten, such as wolfram, tunstate of lime, tungstic oxide and others, and the manufacture and application of its various salts to useful purposes in the arts, such as dyeing textile fabrics, painting on porcelain, and the production of paints and pigments.

"Secondly, in the manufacture and application of the so-called blue oxide of tungsten as a dyeing substance for textile fabrics, and as a paint or pigment.

"Thirdly, the production of paratungstate of alkali, metatungstate of alkali, isotungstate of alkali, and polytungstate of alkali, which may be used in the preparation of paints and pigments, and for dyeing textile fabrics, and other useful purposes, and the combination of paratungstic, metatungstic, isotungstic, and polytungstic acids with any suitable metallic oxide, or mixtures of metallic oxides as a base, such as the oxides of lead, zinc, barytes, lime and others, to form paints and pigments."

In order to obtain the salts or oxides of the new metal, the patentee fluxes the ores with an alkaline salt; but in place of doing this in an ordinary reverberatory furnace, by which the vapour would be lost, he conducts the operation in a retort of iron or fine clay, and conducts the volatile portion into a condensing apparatus.

To procure the metal from the oxide or salt, he reduces with coal, coke dust, or oil, tar, hydrogen, carburetted hydrogen, potassium or sodium.

To produce paints or pigments with chrolithineum, he takes the solution of a salt of it, either alone or mixed with the salt of any other metallic oxide that does not cause a precipitate, and adds the salt of any other metallic salt which *will* cause a precipitate, with or without the addition of any vegetable or animal tinctorial matter. As an example, the patentee cites a process with bichromate of potash, which is exactly the same as that for preparing chromate of lead, except that for a solution of lead he substitutes a solution of chrolithineum. This process for producing a yellow on a textile fabric is also precisely that for dyeing yellow with lead and bichromate of potash. In fact all the evidence given in the patent leads us to believe that chrolithineum is lead, which has been carried over in the distillation in the way that we know it is often carried into the flues of lead reducing furnaces. Of course we do not say that Mr. Emerson has not had the good fortune to discover a new metal, but the patent before us does not prove the fact. If, however, the patentee has been so happy, he may indeed be proud of so brilliant and unlooked for a result. Moreover, as he gets the new metal from wolfram, tungstate of lime, tungstic oxide, it is plain that Scheele, Klaproth, Vauquelin, Berzelius, Wöhler, Malaguti, Laurent and others, have all erred fearfully in their analyses of the ores and salts of tungsten, and have moreover allowed a most brilliant discovery to slip through their fingers.

The patentee prepares his alkaline tungstates, paratungstates, metatungstates, isotungstates, and polystungstates by Laurent's methods, he then claims the salts of these acids

with all the metallic oxides as paints or pigments. He does not, however, state what colours he obtains, and with the metals which give colourless solutions we believe only white precipitates are obtained; but the following are some of the coloured tungstates which are commonly known:

Tungstate of	molybdenum	dark purple
"	chromium	green
"	vanadium	brownish yellow
"	uranous oxide	brown
"	uranic oxide	light yellow
"	cadmium	white, but reddish when gently heated, and bluish black if heated to redness.
"	tin	yellow
"	ferrous oxide	light brown
"	ferric oxide	cinnamon coloured
"	cobalt	violet
"	nickel	light green
"	copper	"
"	mercurous oxide	yellow
"	mercuric oxide	yellow or red
"	silver	white, but brown when gently heated.

From the extreme scantiness of our knowledge upon the compounds of tungsten with the metals, it becomes probable that the patentee will find some valuable pigment among them.

The patent includes the use of the tungstates for dyeing. In using the tungstates, he takes a solution and boils the fabric with it, and then passes the prepared cloth through decoctions of the dye-woods, Persian berries, cochineal, &c. He does not mention the colours obtained, but the subject is interesting, and the patent may, one day, turn out very valuable, if any of the colours are good.

Perhaps the most interesting portion of the patent is where the formation of the blue oxide in tissues is claimed. He boils the yarn, &c. with an alkaline tungstate, and after drying, immerses in dilute muriatic, sulphuric, or acetic acids, and then deoxidises with metallic tin or zinc. We should much like to see some cloth dyed in this way. To sum up, there is much that may be very valuable in this patent, but the information in it as to the nature of the dyes and colours obtained is too vague.

CORRESPONDENCE.

Building Stones.

To the Editor of the Chemical News.

Sir,—I was unwilling to lengthen still further the protracted discussion on Mr. Burnell's paper, but I will now crave permission to say a few words concerning that part of it relating to "salt efflorescences." In the first place the terms "saltpetering" and "nitrification," are apt to suggest to a casual hearer that the substance in question is mainly composed of nitre, or more correctly nitrate of potassium, whereas such is very seldom the case; in fact it is quite the exception instead of being the rule. I have now before me some notes of 37 specimens of "salt" collected from the surfaces of various building materials. Of these 31 contained only sulphate of sodium (with inconsiderable traces of other salts); 3 were mainly composed of the same salt, but also contained sulphates of magnesium and aluminium; 2 samples consisted of sulphate of sodium, together with various phosphates and nitrates, the latter (generally nitrates of sodium and calcium) never exceeding 18 per cent. of the whole. The last specimen was made up of the sulphates of sodium and potassium, with a small amount of nitrates, and a notable quantity of common salt, &c.; this latter ingredient being derived, I imagine, from sea-spray, as the sample was found in a vault at the old castle of Mont Orgueil, Jersey. For all practical purposes I think that sulphate of sodium may be taken as the chief component of those "salt" formations, so destructive to the architecture of this country; and in all building materials, therefore, whether of natural or artificial origin, the absence of this substance should be satisfactorily proved before they are employed for any important work. If due precautions had been taken by the Crystal Palace Company in the selection of their materials, and if surface-water had never been used there for mixing mortars, cements, &c. I feel assured that the salt "efflorescences" apparent in the Pompeian, Byzantine, and other courts, to the disfigurement alike of classical decoration and visitors' coat sleeves, would have been far less injurious, if, indeed, they had not been altogether avoided.

With regard to the preventive means, I can add but little to the mass of information already obtained; but I cannot help denouncing the too free use of resinous, oleaginous, or tarry matters, as my own experiments have shown me that, in the event of fire, the walls of a building treated with such substances would inflame the moment their temperature was raised to about 200°. Still, where a building is to be erected upon a soil known to be impregnated with various salts, the writer's plan of "insulation,"[1] in which the upward percolation of moisture, if the expression is allowable, is prevented by a seam of asphalte laid on every wall, when at a height of from two to four feet from the ground, may be employed with safety and advantage. To the general efficiency of silicate of calcium, or, still better, of aluminium, I can also bear testimony.

In reply to an observation of Professor Ansted's, I may here remark that I have observed silicate of calcium in a partly crystalline condition, when its formation has been very slow, but in this state it is certainly very rare. In relation to curative processes, I am decidedly of opinion that no universal system can be recommended. The plan adopted should always be that most suited to the requirements of each particular case. Where, as generally happens, the efflorescence consists chiefly of the sulphate of sodium or magnesium, a weak solution of chloride of barium may be applied with great advantage, as the original "salt" is then destroyed, sulphate of barium and chloride of sodium (or magnesium) being formed. The first is perfectly insoluble, and the latter, which appears to have little or no action upon building materials, soon gets washed away. This solution, and also one of shell-lac in ordinary borax, was kindly tried for me at the Crystal Palace, by gentlemen connected with the fine arts department, more than three years ago, as far as I can now learn, with entire success. Sulphate of ammonium has, according to my experiments, no injurious effect on buildings until it meets with substances capable of converting it into the corresponding sodium salt; and I consider that its action may be disregarded practically, as its presence in the atmosphere is quite exceptional. Sulphurous acid, also, either free or in combination with ammonia, I believe to have rather a preservative influence than otherwise, as it is never present in sufficient quantity to cause an efflorescence of sulphites; and its compounds with lime, alumina, &c. are very insoluble. It is very probable that the theory of osmosis has been endowed by many with far more important functions in relation to building materials than it really possesses, for, granting that stone has a large amount of air condensed within it when first quarried, the process of diffusion, resulting from occasional and minute differences in the external atmosphere, must proceed but very slowly under the retarding influences of damp and a low temperature. In common with many others, I differ entirely from Mr. Burnell when he designates as "obscure" that branch of chemical science relating to the phenomenon of "salification," as I prefer to call it.—I am, &c.

Wentworth L. Scott.

[1] Adopted at St. James's Hall and other buildings.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

On some Metallic Selenides, by G. Little.[1]—*Selenide of Nickel*, Ni Se, is obtained by heating thin plates of nickel in the vapour of selenium. It is silver white, has a metallic lustre, is unaffected by the atmosphere, but when heated gives off the selenium. It is not attacked by water, dilute or concentrated hydrochloric acid, but is perfectly dissolved by nitric acid and aqua regia. It melts at a strong red heat, and on cooling assumes a regular crystalline appearance; it is brittle, and gives an uneven fracture. The sp. gr. is 8·46. When fused with borax a beautiful golden yellow mass with a striated surface is obtained. It contains 43·13 per cent. of nickel.

Selenide of Cobalt, Co Se, is formed by the action of the vapour of selenium on cobalt in an atmosphere of hydrogen. Seleniuretted hydrogen is formed, part of which is decomposed by the cobalt and part of which escapes. Selenide of cobalt melts at a strong red heat. Fused with borax it gives a yellow crystalline metallic mass. It contains 42·31 per cent. of cobalt.

Selenide of Iron, Fe_2Se_3, containing 32·15 per cent. of iron, the author obtained by heating iron wire in the vapour of selenium. The product was fused with borax in a hessian crucible, and a greyish yellow metallic mass was obtained, which was easily pulverised, which soon changed in the air, and which had a sp. gr. of 6·38. With hydrochloric acid it gave chloride of iron. Seleniuretted hydrogen was developed with diluted nitric acid. It dissolved in strong nitric acid, forming a yellow liquid.

Selenide of Cadmium, Cd Se, which contains 56·76 per cent. of cadmium, is a golden yellow, lustrous crystalline substance which melted with borax, gave a greyish black lamellar, crystalline easily powdered mass, with the sp. gr. 8·789.

Selenide of Tin, $Sn Se_2$, is formed by precipitating chloride of tin with hydroselenic acid. The vapour of selenium unites with melted tin to form a tin white mass, having a metallic lustre, and giving a conchoidal fracture. Its sp. gr. is 5·133. It melts easily, is not attacked by hydrochloric acid, is quickly decomposed by nitric acid, and soon dissolves in aqua regia. It contains 43·71 per cent. of tin.

Selenide of Bismuth, $Se Bi_2$, is not attacked by hydrochloric acid, is only slightly soluble in dilute nitric acid; but is quickly and perfectly dissolved by strong nitric acid and aqua regia. The sp. gr. is 7·406, and its composition approaches the formula $Bi Se_3$. It contains 66·79 per cent. of bismuth.

Selenide of Copper, Cu Se, may be made by precipitating the sulphate of copper with hydroselenic acid; or in the dry way by passing selenium vapour over heated copper foil. In the latter way a greenish black crystalline mass is formed with the sp. gr. 6·655 and the composition Cu Se. It contains 44·03 per cent. of copper.

Selenide of Mercury, $Hg_2 Se$, obtained by heating selenium and mercury together and allowing the product to sublime, forms purple or violet coloured lustrous crystals which have the sp. gr. 8·377. The compound contains 83·76 per cent. of mercury.

Selenide of Lead, properly prepared, has nearly the formula Pb Se, and the sp. gr. 8·154. It contains 71 per cent. of lead.

Selenide of Arsenicum, $As Se_3$, obtained by heating arsenicum with melted selenium, is a shining metallic, friable mass, which is easily reduced to a black powder. The sp. gr. is 4·752. It contains 57 per cent. of arsenicum to 43·03 of selenium. (These numbers have, perhaps, been changed by mistake: to form $As Se_3$ 38·94 per cent. of arsenicum and 61·06 of selenium are necessary.)

II. ORGANIC CHEMISTRY.

Strychnia and Brucia.—M. Stahlschmidt publishes a long memoir on these bodies[2], in which he shows that when an equivalent of their hydrogen is replaced by an equivalent of methyl (C_2H_3) the new compound is quite innocuous. The author proved it by experiments on a rabbit, which suffered no ill effects from the administration of the methylated alkaloid, but died in five minutes after the $\frac{2}{100}$th of a gramme of pure strychnia had been placed upon its tongue.

Methyl-brucia behaves in exactly the same way as methyl-strychnia. M. Nickles[3] points out the fact that substitution does not in every case so completely change the physiological properties of the alkaloids, for chlorinated strychnia is as poisonous as the original strychnia. In these cases however the change has been occasioned by methyl, and it is curious to know that hydrocyanic acid in combination with methyl is perfectly inoffensive.

The methylated bases are prepared by the ordinary processes. The alkaloid in fine powder is placed in contact with iodide of methyl which combines with it, forming a new compound which is the iodide of base substituted:

$$C_{44}H_{24}N_2O_4I \text{ or } N\left\{\begin{matrix}C_{42}H_{20}N_2O_4\\C_2H_3\\H\end{matrix}\right\}I.$$

This iodide is very soluble in warm water, and slightly so in cold. It is decomposed by the salts of silver, which fix the acid and form iodide of silver. It is not volatile. In contact with oxide of silver and a little water it yields the free base—hydrate of methyl-strychine; which however may be obtained more easily by decomposing the sulphate with baryta water. The liquid is coloured violet at first, but long yellowish crystals soon appear, which do not change when exposed to the air, and contain 16 or 17 per cent. water. This is the hydrated base. It is very soluble in water and in alcohol, but insoluble in ether. It displaces the principal metallic oxides from their combinations, and is coloured brown when treated with peroxide of lead or bichromate of potash and sulphuric acid. The author has further studied the various compounds this base forms with acids.

Methyl-brucine is obtained like the preceding, but it is difficult to isolate the hydrated base. It forms compounds in every respect similar to those of methyl-strychnine. The hydriodrate of methyl-brucine, $C_{46}H_{29}N_2O_8 + I$, crystallises in brilliant lamellæ. From what precedes the authors conclude that strychnia and brucia are two bases of the same class as the ammonias.

III. CHEMICAL ANALYSIS.

Detection of Protoxide of Copper in the Presence of Binoxide.—Protochloride of copper reduces sesquichloride of iron even in the cold, and such a solution is not coloured red by the sulphocyanide of potassium; on the contrary, it decolorises a solution prepared with a salt of the sesquioxide of iron and a sulphocyanide. These reactions do not take place in the presence of albumen which precipitates the ferric salts. In such a case Schiff[4] employs with success a solution of iodic acid and starch. The least trace of the protoxide of copper is shown by reduction of the iodic acid, and the production of the blue iodide of starch. When the liquid is alkaline it must be neutralised with pure hydrochloric acid.

Similar reductions take place with chromic, molybdic, and tungstic acids. With protoxide of copper dissolved in ammonia, chromic acid is reduced to the green oxide, tungstic acid to the green sesquioxide, and molybdate of ammonia to the blue oxide. Schiff prefers iodic acid to these reagents, because it is easily procured, and because albuminous liquids do not interfere with the action.

IV. TECHNICAL CHEMISTRY.

Calcium.—A ready way of procuring calcium has been discovered by M. Caron.[5] He heats in an ordinary furnace a mixture of fused chlorine of calcium in powder, 400 parts

[1] *Annal. der Chem. und Pharm.* Bd. cxii. s. 211.
[2] *Annal. der Physik und Chem.* Bd. cviii. s. 513.
[3] *Journ. de Pharm. et de Chimie*, Mars 1860.
[4] *Annal. der Chem. und Pharm.* Bd. cxii. s. 211.
[5] *Comptes-Rendus.*

of granulated zinc, and 100 parts of sodium — using as great a heat as possible, but preventing the volatilisation of the zinc. An alloy of calcium and zinc is found in the crucible, whilst the preparation is finished, which is then heated in a carbon crucible until all the zinc is driven off. The author hopes to procure barium and strontium in the same way.

SCIENTIFIC NOTES AND QUERIES.

Mulder's Process for Determining the Amount of Alcohol in Wines and other Alcoholic Mixtures. — Sir, — Your correspondent *E. G.* (Chemical News, No. 9, p. 108) so unjustly condemns as incorrect the useful method of Mulder for determining the amount of alcohol in wines and other alcoholic fluids, that it is but fair to set your readers right upon the subject. In this method, of which it will be recollected that an example was given in No. 3, p. 36, the sp. gr. of the alcoholic fluid to be examined is taken, and half being then evaporated away the residue is increased with water to its original volume. The sp. gr. of this mixture being then taken, the latter sp. gr. is deducted from the former, and the result is the sp. gr. of the alcohol and water as they existed in the fluid. *E. G.* sets out with the assertion that the result obtained in the working of the example is erroneous :

Sp. gr. of the wine	0·9953
Sp. gr. of the mixture	1·0080
	0·9873

"9873," he says, "is not the difference between 1·0080 and 0·9953 : the difference is ·0127." Now it is evident that if 0·9953 were subtracted from 1·0080 the difference would be ·0127, but then the reverse of this operation is distinctly indicated and the difference is thus clearly 0·9873. *E. G.* then gives a rule for the correct working of the problem, which I deduce from his formula to be this :—The specific gravity of the alcohol and water evaporated ; that is, forming half the volume of the fluid is obtained by subtracting twice the difference between the specific gravity of the wine and that of the mixture from 1000. The example in question would according to this rule be worked thus :

1·0080 − 0·9953 = ·0127
·0127 × 2 = ·0254
1000 − ·0254 = ·9746 = the sp. gr. of half the original volume.

According to Mulder's working the specific gravity is ·9873, but then it must be remembered that this latter is the specific gravity of the alcohol and water *as they existed in the wine*, and not in half its volume. The result obtained by *E. G.* may thus be shown to exactly coincide with that given by Mulder, for if ·9746 be increased by 1, and this divided by 2, the specific gravity of the alcohol and water as they exist in the wine is obtained :

$$\frac{1{\cdot}9746}{2} = {\cdot}9873.$$

Or if the multiplication of the difference between the specific gravities be neglected, the same result will be arrived at : 1000 − 0·0127 = ·9873. The methods of Mulder and of *E. G.* give, therefore, precisely similar results, if the volume of fluid whose specific gravity is ascertained be always borne in mind. I may add that, from having repeatedly compared the results obtained by the ordinary mode of distillation with this method, I am perfectly satisfied of its correctness, while the great facility and rapidity with which the operation is performed, recommend it above every other with which I am acquainted.—*H. Napier Draper, F.C.S.*

LABORATORY MEMORANDA.

Apparatus for keeping a Liquid at a constant Level.—Sir,—Having recently been engaged in some experiments on solutions requiring the loss by evaporation to be made up from time to time, I was induced to construct an apparatus which should perform this duty without the necessity of continual supervision. Thinking the arrangement may be of use to some of your readers I will endeavour to describe it. A flask is provided to contain the supply of water or other liquid, to which is fitted a cork pierced with two holes ; into each of these holes is inserted a tube bent twice at right angles in such a manner as to form a syphon. One of these tubes (which I will call the first) descends to the bottom of the flask, the second tube terminating in the top. All the joints must be made airtight, and it is then ready for use in the following manner : the flask and first tube is filled with water, and the thumb being placed over the orifice, the two tubes are placed in the vessel containing the solution in such a manner that the second tube shall just reach the level it is desired the water shall keep. The thumb being now removed the water will flow into the vessel until the orifice of the second tube is covered, when the flow of water will stop until by evaporation the orifice is again exposed, when the syphon will again act. The apparatus will continue to act in this manner until the liquid attains the same level in both vessels. It may be filled either by a third tube, which must be capable of being closed airtight at pleasure, or by inverting the apparatus and inserting a funnel into one of the tubes. By means of a perforated cork the apparatus may be fitted to a retort or gas apparatus.—*John Tillman.*

MISCELLANEOUS.

Clarifying Coal Oils. — Messrs. Dumoulin and Cotelle have been making a series of experiments with a view of rendering heavy oils suitable for ordinary lighting purposes, and have succeeded in producing a magnificent light, free from smoke and smell, and adapted in all respects for burning in a room. The following is their process :—In a close vessel are placed 100 lbs. of crude coal oil, 25 quarts of water, 1 lb. of chloride of lime, 1 lbs. of soda, and half a pound of oxide of manganese. The mixture is violently agitated and allowed to rest for 24 hours, when the clear oil is decanted and distilled. The 100 lbs. of coal oil are to be mixed with 25 lbs. of resin oil ; this is one of the principal points in the manipulation, it removes the gummy parts from the oil and renders them inodorous. The distillation spoken of may terminate the process, or the oils may be distilled before they are defæcated and precipitated.—*Le Génie Industriel.*

Transparent Ivory. — The process for making ivory transparent and flexible is simply immersion in liquid phosphoric acid, and the change which it undergoes is owing to a partial neutralisation of the basic phosphate of lime of which it principally consists. The ivory is cut in pieces not thicker than the twentieth part of an inch, and placed in phosphoric acid of a specific gravity of 1·131, until it has become transparent, when it is taken from the bath, washed in water, and dried with a clean linen cloth. It becomes dry in the air without the application of heat, and softens again under warm water.—*Druggists' Circular.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Selenium.—1. No. 2. No. But you must not call yourself a *pharmaceutical* chemist.

A Chemical Student.—Enter at the College of Chemistry or some other laboratory if possible. If not get some book on analysis and work straight through it at home.

Enterarmiá.—1. The ointment will keep well in cold weather, but the consistence will necessarily vary somewhat with the temperature. In the case of the clarified butter at 9*d.* per lb. is our correspondent certain that the whole of the mercurial solution was mixed by the "occasional" stirring ? 2. The easiest way to separate cadmium from zinc ore is to dissolve in sulphuric acid, supersaturate with the acid and precipitate with sulphuretted hydrogen. The sulphide of cadmium is then reduced and distilled.

Your Subscriber.—No ; it is not however "carbonising," but the escape, or efflorescence, of the water of crystallisation. Faraday says that crystals having no part of their surface broken, and carefully preserved from external violence, remain perfect.

A Subscriber.—1, A mixture of the best ivory black and spirit varnish carefully applied. 2. We do not know of any.

W. J. J.—Consult Thomson's *Treatise on Distillation.*

S. K. E.—Probably none, unless it be added in large excess, which is not likely to be done.

Erratum.—P. 175, col. 1, lines 14 and 21, for "*Eames*" read "*Lames.*"

Books and Papers received.—*Introductory Lecture* delivered in the Carmichael School of Medicine, by E. W. Davy, M.B. &c. &c. Lecturer on Chemistry, Carmichael School. *On a Simple and Expeditious Method of Estimating Phosphoric Acid, &c.* by E. W. Davy, M.B.

*** All *Editorial Communications* are to be addressed to the Editor ; and *Advertisements* and *Business* communications to the Publisher, at the Office ; 12 and 13 Red Lion Court, Fleet Street, London E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks upon the various Methods usually adopted for the Separation of the Alkalies from the Bases with which they are generally associated in Soils, Minerals, &c. by FREDERICK FIELD.

THE separation of potash and soda from other metallic oxides, and particularly that of magnesium has always been considered a very delicate and somewhat difficult matter in chemical analysis. It is needless to observe that in the investigation of soils, minerals, glass, and some metallurgic products, such as slags, &c. great importance should be attached to their correct estimation; and although many excellent processes have been devised, it can scarcely be denied that at the best chemists must consider the determination of the alkalies as a responsible, and at times not a very satisfactory affair, owing to the comparatively minute proportions in which they generally exist, and the number of operations the substance containing them has to undergo before their complete elimination.

It is intended in the following remarks to recapitulate as briefly as possible some of the methods usually adopted, together with their attendant advantages and disadvantages.

1. *Fusion of the substance with hydrate of baryta.* A certain quantity of the mineral or other substance to be analysed is heated to bright redness with about four times its weight of hydrate of baryta in a platinum crucible for nearly an hour; the mass is not entirely fused, but agglomerated, and if the heat has not been too elevated, the contents on cooling may frequently be removed from the crucible by a slight pressure on its sides and a little skilful manipulation. When the temperature has been excessive, the mass is difficult of removal, and the platinum is acted upon by the baryta, not only deteriorating the crucible, but causing a loss of potash, as by subsequent digestion in hydrochloric acid, the double chloride of platinum and potassium is liable to be formed, which remains with the silica after evaporation to dryness. Independently of this, the solution of the compound in the crucible is very tedious, from the great insolubility of chloride of barium in hydrochloric acid, a layer of this salt forming upon the surface of the undecomposed carbonate, and retarding the action of the acid. The preliminary removal of the contents of the crucible is therefore of some importance, provided it can be effected without loss. Dilute hydrochloric acid is added, and after complete solution the whole is evaporated to dryness. On removal of the silica by filtration, hydrate of baryta is added until the solution is decidedly alkaline, the precipitate filtered off, and carbonate of ammonia, mixed with free ammonia, is added in excess; the liquid is heated, allowed to stand for some time, and filtered with the usual necessary washings, the filtrate evaporated to dryness, and ignited. The excess of ammoniacal salts is volatilised, and the alkalies estimated in the usual manner. I have always found a considerable difficulty in this process, viz. the entire separation of the baryta by means of carbonate of ammonia. Even after boiling the strongly alkaline liquid produced by adding an excess of this reagent, baryta is recognised in the filtrate, and has again to be separated. As it is advisable to obtain the alkalies in union with hydrochloric acid for the separation of the potash from the soda by means of chloride of platinum, the simple addition of sulphuric acid for the removal of the baryta is inadmissible.

The alkaline chlorides together with the excess of carbonate of ammonia, and carbonate of baryta must be ignited, weighed, and the latter collected, estimated and deducted from the weights of the mixed carbonates after ignition.

There is no doubt, I believe, that carbonate of baryta is soluble to a slight extent in solutions of ammoniacal salts, more especially in chloride of ammonium. Even the sulphate is very slightly soluble in both nitrate of ammonia and chloride of ammonium.

Perhaps a more advisable method than the preceding, and one adopted many years ago by Berzelius, consists (when the alkalies and other bases exist as sulphates), in decomposing by acetate of baryta, filtering and igniting. The alkaline carbonates can then be separated from the rest by the addition of boiling water.

By this means ammoniacal salts may be altogether avoided. In the filtrate from the silica, dilute sulphuric acid is added, and the baryta entirely precipitated, whilst all the other bases remain in solution as sulphates; the addition of acetate of baryta converts them into acetates, which by ignition are reduced to carbonates (in the case of iron, to peroxide), and the alkalies separated by solution in water.

Lime, magnesia, and the alkalies may be determined in a soil or mineral product without the necessity of two fusions, as is usually the case, by adopting either one of the two following methods.

To the filtrate from the silica sulphuric acid is added, so as to precipitate nearly all the baryta, yet leaving the latter in slight excess; the sulphate is filtered off, and oxalate of ammonia added, which throws down the lime and the remaining small quantity of baryta. After washing, the precipitate is ignited with the usual precautions, and weighed; redissolved in hydrochloric acid, sulphuric acid added, the precipitate thoroughly washed, dried, ignited, the weight of the baryta calculated from the sulphate, and deducted as carbonate, from its admixture with the carbonate of lime. The magnesia and alkalies according to Heintz [1] may be separated as follows. To the filtrates from the oxalates of lime and baryta, phosphate of ammonia is added, which precipitates the whole of the magnesia. After filtration the phosphoric acid is precipitated by a solution of nitrate or acetate of lead, and the excess of lead removed by boiling with carbonate of ammonia and ammonia. After filtration, the alkalies with the ammoniacal solution are

[1] *Q. Journ. Chem. Soc.* vol. i.

evaporated, ignited, and the former estimated in the usual manner.

Sonnerschein's method [1] may also be advantageously adopted under similar circumstances.

After removal of the lime, the filtrate is evaporated to dryness, and gently ignited. Water is poured upon the dry mass when cool, and it is then boiled with carbonate of silver until the liquid has a strong alkaline reaction. After about ten minutes boiling the decomposition is generally complete. The alkalies with a trace of silver are in the filtrate, and the whole of the magnesia with the precipitate. A few drops of hydrochloric acid remove all the silver, and the alkalies can be readily estimated. The addition of the same acid forms an insoluble chloride with the precipitate, dissolving the magnesia, which can be determined as pyrophosphate, by addition of phosphate of soda in its ammoniacal solution.

When, however, the alkalies and magnesia are together as sulphates, the following method as suggested by Ebelman, may be adopted. That chemist having found considerable mechanical difficulties in filtering the sulphate of baryta, formed by the decomposition of the acetate of that base, proposed heating the sulphates of magnesia, potash, and soda, with carbonate of baryta suspended in water. This plan was not effectual, as the decomposition was incomplete, and sulphuric acid was always found in solution.[2] If the liquid, however, be acted on simultaneously by carbonate of baryta and a current of carbonic acid, a bicarbonate of baryta is formed, and consequently no trace of sulphuric acid can exist. The alkalies also are converted into bicarbonates, together with a portion of magnesia. On filtering, evaporating to dryness, and digestion in water, the alkalies are dissolved, and the magnesia can be separated from the baryta by means of sulphuric acid.

There are still simpler methods for the separation of magnesia from the alkalies, of which mention will be made in the next number.

(To be continued.)

On the Formation of Tartaric Acid from Sugar of Milk and Gum, by J. VON LIEBIG.[3]

WHEN a mixture of one part of sugar of milk, two and a half parts of nitric acid, sp. gr. 1·32, and two and a half parts of water, is moderately heated, carbonic acid and gaseous products of the decomposition of nitric acid are disengaged, and there separates, after continuing the heat for some time, a thick white magma of mucic acid. Diluted with an equal volume of water, and filtered from the mucic acid, the liquid obtained yields a fresh portion of mucic acid on being again heated with one fourth of the nitric acid before employed. The whole of the mucic acid obtained amounts to about 33 per cent. of the sugar of milk. It follows that the greater part of the milk sugar must have escaped in the form of the gaseous products of oxidation, or be contained in the acid mother liquor, from which the mucic acid has been deposited. This liquid has a yellowish colour, and when concentrated by evaporation yields a thick acid syrup, which frequently under 100° becomes at first brown and then black. When the mother liquor, from the mucic acid, and the washings are mixed and boiled, carbonic acid and nitric oxide are disengaged, and the liquid becomes dark brown; but this last effect may be prevented by the addition from time to time of more nitric acid. After continuing the boiling for 18 or 24 hours, the liquid no longer turns brown on neutralising with potash. At this time it contains a large proportion of tartaric acid. It is now concentrated by a gentle heat, and divided into two parts: one is saturated with potash, and the two are then poured together and allowed to stand, when crystals of bitartrate of potash are deposited. These are sometimes mixed with needle-like crystals of saccharate of potash, which, being more soluble than the bitartrate, may be easily separated by dissolving the two in as small a quantity of boiling water as possible, and quickly cooling the solution. In this way the bitartrate is separated in the form of shining crystalline granules. By standing longer, the mother liquor yields the fine needle-like crystals of the saccharate of potash.

Two analyses of the artificially formed bitartrate gave the following results:—

	I.	II.	Calculation $C_8H_5KO_{12}$
Potash . .	24·5	24·3	25·06
Tartaric acid . .	75·5	75·7	74·94
	100·0	100·0	100·00

By adding nitrate of silver to the neutral potash salt, a white precipitate is thrown down, which quickly turns black in the light. On igniting the dry precipitate, 59 per cent. of metallic silver is left behind.

By neutralising the acid potash salt with soda, and slowly evaporating the solution, very beautifully formed crystals of Rochelle salt are obtained. After digesting the acid potash salt with antimonic oxide, well defined crystals of tartar emetic are deposited.

After these results, we can have no doubt of the formation of tartaric acid by the oxidation of milk sugar. It is also obtained when gum arabic is treated with nitric acid in the same way.

Besides mucic, saccharic, and tartaric acids, some oxalic acid is formed. The saccharic acid is in largest proportion immediately after the separation of the mucic acid; but by longer boiling with fresh additions of nitric acid it becomes decomposed, and the amount of tartaric acid in the residue increases.

A long illness has prevented Liebig from carrying out a series of experiments to decide the question whether the tartaric and saccharic acids are formed simultaneously, or first saccharic and then tartaric acid. He conjectures, however, that the latter is the fact—that the tartaric is formed from the saccharic acid.

From grape and cane sugar Liebig could not obtain tartaric acid, but as a small per centage of saccharic acid was formed from both, he believes the reason of his failure was the small quantities operated on.

On subtracting the formula of tartaric from that of saccharic acid, there remains a body with the composition of the carbohydrates:—

Saccharic acid . . .	$C_{12}H_{10}O_{16}$
Tartaric acid	$C_8\ H_6\ O_{12}$
	$C_4\ H_4\ O_4$

The elements of the last subtracted from tartaric acid leave oxalic acid:—

Tartaric acid	$C_8H_6O_{12}$
Carbohydrates . . .	$C_4H_4O_4$
Oxalic acid	$C_4H_2O_8$

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[1] *Poggendorff's Annalen*, lxxiv. p. 313, and *Chem. Gaz.* vol. vi. p. 284.

[2] The sulphates of the alkalies, as is well known, are not decomposed to any great extent by carbonate of baryta when their solutions are heated. They are however completely decomposed in the cold. A warm solution of sulphate of magnesia is, on the contrary, rapidly and entirely decomposed by carbonate of baryta, although the decomposition is tedious at ordinary temperatures.—F. FIELD.

[3] *Annalen der Chemie und Pharmacie*, Bd. cxiii. s. 1.

Liebig believes that oxalic acid is the first acid product formed in a plant from carbonic acid, and that tartaric and malic acids are derived from oxalic. By exchanging two equivalents of oxygen for two of hydrogen, oxalic acid becomes malic; by exchanging four of oxygen for four of hydrogen, it produces aldehyde. Malic acid therefore may be considered as oxalic acid half changed into aldehyde.

To become tartaric acid, malic acid has only to fix two equivalents of oxygen:—

Malic acid	$C_8H_6O_{10}$
Tartaric acid	$C_8H_6O_{12}$

Tartaric acid then is only a product of the oxidation of malic acid; and this explains the constant presence of malic acid in unripe grapes.

TECHNICAL CHEMISTRY.

On a new Mode of Preparing Calcium, by M. H. Caron.[1]

Last year I had the honour to present to the Academy a new process for reducing the chlorides of calcium, barium, and strontium, and obtaining these metals alloyed with others, such as lead, tin, antimony, and bismuth. At that time I had not been able to separate the alkaline metal from these alloys; but since I have resumed my researches I have been able to isolate calcium. The following is the proceeding I have adopted. I make a mixture of 300 parts of fused chloride of calcium in powder with 400 of finely granulated distilled zinc, and 100 parts of sodium in small pieces. The whole is placed in a crucible and heated to redness in an ordinary furnace. At first the action is very feeble; but after some time we see zinc flames issue from the crucible. The heat must now be moderated to prevent the volatilisation of the zinc, but at the same time it must be maintained as high as possible. This is the most delicate part of the operation, and it requires the greatest care to arrive at a satisfactory result.

When the crucible has remained in this state for a quarter of a hour it may be withdrawn from the fire; and after cooling there will be found at the bottom a metallic button, very brittle, showing a brilliant fracture, and sometimes crystallised on the outside in prisms with square bases. It generally contains from 10 to 15 per cent. of calcium.

This alloy of zinc and calcium is scarcely acted on by water, especially at the ordinary temperature: oxalic and sulphuric acids have but a feeble action on it, in consequence of the insolubility of the salts produced; hydrochloric and nitric acids on the contrary rapidly dissolve it.

To procure the calcium from this alloy it is only necessary to put it into a coke crucible, and drive off the zinc by heat. It must be placed in the crucible in pieces as large as possible, or the calcium collects with difficulty. The alloy ought not to contain sodium (which will happen when the operation has been badly conducted) or the crucible cracks and the calcium is obtained badly aggregated and only in very small quantity. The alloy cannot be distilled either in lime or ordinary crucibles.

When the above precautions have been observed a button of calcium is obtained, only contaminated with the foreign metals which were originally contained in the zinc, or matters which may have been derived from the crucible.

The calcium I have so procured always contains traces of iron, and always has a brass-yellow colour when recently scratched. I have found its density to be 1·6 or 1·8, but the numbers are necessarily too high in consequence of the iron which it contains.

It is not sensibly volatile alone, but the zinc with which it is alloyed, in distilling, carries over a small quantity. In contact with moist air it breaks up like ordinary lime, leaving a greyish powder a little reddened by the iron. When enclosed in a well-dried bottle it keeps well, assuming, however, almost immediately a grey tint, which completely destroys the metallic appearance of it.

It burns with difficulty in the blowpipe flame because of the covering of lime immediately formed. The combustion of its filings gives rise to red sparks of remarkable beauty. No fumes are disengaged when it burns, which goes to prove that it is not volatile at the temperature of its combustion.

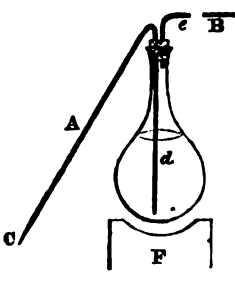
Before terminating the communication it is necessary to indicate one precaution which is indispensable in order to obtain the calcium pure. If commercial zinc be employed, however pure it may be, it always contains lead and iron, which are collected in the button in large proportion, because of the quantity of zinc with which the calcium is alloyed. And not only do we find the lead and iron contained in the volatilised zinc, but some zinc itself which the lead and iron retain and make it impossible to drive off. With the zinc of commerce I obtained a button of calcium containing:

Calcium	78
Lead	9
Zinc	11
Iron	2
	100

It is necessary therefore to employ distilled zinc, and then the calcium is obtained pure, or at most containing but traces of iron from the crucible.

Self-acting Wash-bottle. By Thomas Salter, *F.C.S.*

The following simple modification of an ordinary wash-bottle is convenient in those cases where a continuous supply of water is desired, whether hot or cold, in a thin stream or a succession of drops; and where the passage of the liquid through the filter is sufficiently rapid. The shorter limb *d* of the syphon-tube A, drawn out to a point at *c*, passes through the cork nearly to the bottom of the flask, which is filled up to the neck. By blowing air through *e*, the water is forced through A out at *c*, whence it will afterwards continue to issue of itself. The supply can be at once stopped by sucking air through *e*. To prevent the flask, *as it empties*, being tipped over by the weight of the syphon-tube, a block of wood hollowed in the middle (F) is useful as a stand.



In order to obtain a succession of drops, a short piece

[1] From the *Comptes-Rendus*, t. l. p. 547.—In our last number we gave a short abstract of this process, to-day we give the communication at length.

of tubing, drawn to a fine point at one end, has tightly rammed into it some cotton wool (B), and is then attached to the tube *e* by means of caoutchouc while the water is running from *c*. The cotton must not however *entirely* exclude the admission of air.

By slightly varying the size of the pointed orifice and the tightness of the wool, the supply of water may be regulated at pleasure. It is as well therefore to keep a few of these easily made drop-tubes ready at hand.

PHARMACY, TOXICOLOGY, &c.

Note on the Processes Employed by Chemists to prove Poisoning by Phosphorus, by M. Filhol.[1]

The frequency with which phosphorus has been used as a poison within the last few years has for some time attracted the attention of physicians and chemists. There is no doubt that in the present day the use of phosphorus has superseded that of arsenic in criminal poisonings; and the proof of poisoning by phosphorus in some cases presents serious difficulties of a nature to embarrass the most experienced chemists.

Three sorts of cases may present themselves. The first are those in which the matters to be examined may still contain some traces of free phosphorus. In such the process of Mitscherlich, with some modifications, may enable experts to arrive at positive results.

The second cases are those in which the suspected matters no longer contain free phosphorus, but may yet have some phosphorous acid. To prove the presence of phosphorous acid in the suspected matters may also lead to the proof of poisoning by phosphorus; but this proof involves a most delicate research. It is not sufficient to establish the fact that the substances operated on possess a decided reducing power, in order to be able to affirm that phosphorous acid has been found. It is necessary to prove that the phenomena of reduction observed are really owing to the phosphorous acid, and not to the organic matters which accompany it. But the facility with which phosphorus is changed into phosphoric acid in the operations, joined to the difficulty experienced in separating it from the organic matters which are associated with it, frequently hinder the chemist from arriving at an affirmative conclusion.

The third cases are those in which the matters under examination contain neither free phosphorus nor phosphorous acid.

Most of the authors who have written on poisoning by phosphorus direct us in such cases to determine the exact amount of phosphoric acid in the suspected matters, and to compare this quantity with that yielded by substances of the same nature obtained from subjects not poisoned. A report by MM. Persoz, Opperman and Villemin is generally quoted as a model to follow. These gentlemen have laid down rules to be followed in all cases in which neither free phosphorus nor phosphorous acid can be found. The report is a very remarkable one, and it led, in the case on which these gentlemen were consulted, to the discovery of a crime which would probably have remained unpunished but for the ability of the experts.

We may, however, inquire whether researches of the same kind would lead to the certainty that poisoning had taken place, if they were not, as in this particular case, corroborated by certain facts, which by themselves constituted almost as strong proofs as those which were obtained by chemical analysis. In order that we may safely infer that a subject has been poisoned from finding more phosphorus (in the form of phosphoric acid) than would be found in the most phosphorised matters of the animal economy, it is necessary to demonstrate that the tissues of a man and the alimentary matters which may be found in his digestive apparatus, can in no case contain a larger amount of phosphorus than that found in the most phosphorised matters of the system. But as yet no investigations have been made to establish:

1. Within what limits the amount of phosphoric acid found in the tissues of the body may vary; we do not know whether age, health, or sickness, or even certain pathological alterations may not produce an abnormal abundance of phosphoric acid and phosphates.

2. It is necessary also that we should know with certainty whether the phosphate of lime in bone may not be dissolved in some culinary operations on meats, and so a substance be introduced into the system much richer in phosphorus than any of those which compose our tissues. If such should be the case it will not be sufficient merely to estimate the phosphoric acid, but it will be important to show that this acid was not found in form of phosphate of lime.

[1] *Journ. de Méd. de Toulouse.*

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM, 21 *March* 1860.

On the Adulteration of Food, by Ed. Lankester, *M.D., F.R.S.*

I have thought it would only be a proper termination to these lectures if I made some remarks upon the subject of the adulteration of food. I have already mentioned the fact that many of the necessaries of life are fraudulently adulterated, and it is to this subject that I wish to draw your attention this evening. The whole subject of adulteration would, however, be far too wide a field for me to take up, and I must consequently confine myself to a few of the most important articles of food, and some of the most common forms of adulteration; I will also, as far as possible, confine myself to those adulterations which I think persons in almost any station of life will be capable of detecting; and I shall point out the method of detecting those adulterations, in such a manner that I hope every one of my audience will find themselves competent to repeat the experiment.

There are a few important points of view from which the subject of adulteration of food may be regarded: the first is that the public on purchasing adulterated food has to pay an exorbitant price for the article; for they do not pay for the *real* substance (which might be worth the money), but for an *inferior* article which is not worth so much. Hence a large amount of income is taken out of the pockets of those who purchase. But there is another more important view than this, which is, that those who will thus pick our pockets will not hesitate to take our lives; for many of the substances which are added to food are really poisonous in their nature, and thereby destructive effects sometimes take place as the result of these adulterations. I will just point out a few of the instances which I recollect at the present moment in connexion with the poisonous effects of adulterated food. I recollect a short time since at a public dinner that the person who supplied the dinner placed upon the table some green blanc-mange. Now he had gone to the chemist and druggist for a substance with which to produce this green, to please the eye and tempt the appetite, and the chemist had given him arsenite of copper, also known as Scheele's or Schweinfurth green; this beautiful substance which is used to colour paper hangings, and which even in that case

may sometimes be a source of poisoning; and the consequence was that, as the result, five or six persons were poisoned, and two or three died. Now here we have a case in which fraud was not intended, but for all that it was really a fraud to induce a person by means of a beautiful colour, to take poisonous food. It is only a few weeks ago since we read in the *Times* newspaper of several children at Clifton having been poisoned by some very yellow-looking Bath buns. I do not know what is the object of colouring them yellow, but I suppose it is for the purpose of making them to appear to have a quantity of eggs in them. In this case, however, the yellow colour was not made with the yolk of eggs. The person who made them had gone to the chemist and druggist, and asked him for something to make his buns look yellow. The chemist had intended to have given him chromate of lead, or chrome yellow, as it is called. But it so happened that the druggist, as is frequently the case, made a mistake, and gave him sulphide of arsenic, or *orpiment*, and the consequence was that instead of a slightly poisonous substance, he obtained a very poisonous substance, and two or three boys nearly died. There was a more melancholy case than this occurred at Bradford, and here was another case in which the druggist made a fatal mistake. Here is some plaster of Paris,—or sulphate of lime,—which is used for adulterating sugar lozenges, and called "*daft*." This substance was applied for, but instead of giving plaster of Paris he gave *white arsenic*. When the lozenges were sold in the market-place at Bradford, the consequence was that fifteen persons were killed, besides many more being made seriously ill; so that you see the habit of adulteration leads to results which are frightful to contemplate. The man who wanted to put upon the table green blanc-mange, was simply wanting to tempt appetite by a particular colour. The man who wished to tempt appetite by colour in the buns, poisoned his customers, and the same in the case of the "daft." I shall have a word or two to say about the state of the legislature presently, which allows fraud of this nature to pass far too lightly. The man who picks your pocket, or steals your game, is sent to gaol,—the man who takes your life on the highway is hanged, but the adulterator who gives you slow poison goes scot free.

Now it is not alone that persons are thus poisoned and defrauded of their money, but the consequence of many of these adulterations is that people are not properly nourished, they do not get the right kind of food. If you give a child flour mixed with chalk or sulphate of lime, you are gradually undermining that child's constitution by depriving him of the phosphate of lime necessary for the formation of bone, and there are many cases in which, when bread has been permanently adulterated in this way, that persons, children especially, have lost their lives.

There is some difficulty in knowing what to call adulteration. The substitution of any one thing for another, with the intention to deceive, or with the intention to obtain more money than the thing is worth, is an adulteration. There are some things which are supposed to be improved by the addition of other substances, and these are commonly supposed not to be adulterations, and it would appear that in order to convict a person of adulteration there should be the intention of deceiving for gain. Now with regard to the more intimate nature of these adulterations. At first sight, when we glance our eyes around at the various kinds of adulteration, it would be difficult to classify them, but Dr. Hassall, who has written and done so much good in this respect, divides adulterations into three kinds: first, the addition of substances to increase the weight or bulk of food; second, the addition of substances to give the rich flavour or pungency of good food to inferior food; and thirdly, the addition of substances to give false or imitate natural colours. And I will just give you some instances of these different kinds. Taking those adulterations which are used for adding bulk and weight, we may divide them into two kinds, those in which addition is made of inferior or cheaper articles of the *same* kind, and those in which cheaper articles of *another* kind are added; for instance, I may say that when arrow-root is adulterated with inferior kinds of potato starch, it of course lowers the price to the seller, who however charges full price to the consumer, as though it were the real substance. Now potato starch is sometimes added to the arrow-root, and sometimes other starches. We find also that tea is adulterated with spent tea-leaves; this is the same kind of leaf, but it has lost its value and quality by use: these leaves are dried, made up, and added to the unused tea. We have, however, a large number of instances where the object is to increase the bulk and weight of the article by the addition of other substances. Thus, for instance, in bread we have mashed potatoes sometimes mixed with wheat flour, and although we might say that mashed potatoes contain starch as well as wheat, yet if we pay for good wheaten bread we have a right to have it. Then we find that butter is adulterated with lard, and that is a very difficult adulteration to detect. Coffee is adulterated with chicory, which is ground up and used instead of the coffee berry. Then milk is adulterated with water, which is a very different thing to milk. Pepper is adulterated with flour. Tobacco is adulterated with water and other leaves; and I might go over a great many substances which are adulterated for the purpose of increasing their bulk. Then we have another kind of adulteration; things are added fraudulently to articles to increase their pungency and flavour, and here water plays a very important part. For instance, vinegar is adulterated with sulphuric acid, by the addition of which the acidity is increased very much, and the adulterator is thus enabled to add a considerable quantity of water. Then beer is adulterated with salt and treacle. Now salt and treacle enable the person who adulterates to add water without destroying the power of forming a *head* when poured out. Powdered ginger has flour added, and then Cayenne pepper, for the purpose of making up the pungency. Then certain adulterations are used for the purpose of giving colour, for there is a great tendency in the public to prefer bright and intense colours; and we thus find that even such a thing as these anchovies could not come into the market without being mixed with Venetian red or peroxide of iron. Then coffee, in order to make it look of a darker colour, is adulterated with burnt sugar, *black jack* as it is called. Cocoa paste is adulterated with red lead; and as to confectionary, there is no end to the variety of injurious or poisonous colours used.

These, then, are the principal forms which adulterations assume, and the question comes what means can we employ to detect these adulterations? At first sight it seems a very difficult thing for the public to do, and the government is now engaged in passing through the Lower House a bill by one of the clauses of which analysts may be appointed in many districts, who for a certain price will have to analyse all kinds of food which may be brought to them. At the same time it is not so difficult a matter as at first sight it might be supposed to detect adulterations, and I will now draw your attention to some of the means which may be employed, namely, the microscope and chemical analysis. I will allude first to the microscope, which has become now so much an instrument of education that every person ought to possess one, and I have no hesitation in recommending its study not only to those who make scientific investigations, but also to every housewife: for you can imagine how much benefited a blind housekeeper would be if she could have a pair of eyes, but I venture to say that a housewife *with* eyes would be just as much benefited by the aid of a microscope as the blind housewife would be by the use of a pair of eyes. By the aid of a microscope we have a new world opened to us, and if any instrument could have been made purposely to arrest the progress of the adulterator more advantageously than another, I think it would be the microscope. As we shall have occasion to speak very frequently of the microscope, I will remark that although you may spend very advantageously your 50, 100 or 150 guineas (and I do not know, if you had the money, that you could spend it more advantageously than upon a good microscope),

those who have not the 150 guineas can purchase a very good small one for 30*s.* with which you can see hundreds of kinds of adulterations.

The other great detector is chemical analysis. That is not quite so easy, for it requires you to get up a little knowledge of chemistry — of the compounds of elements, of acids, bases and salts, and some of the general laws of composition and decomposition. But that is not so difficult if persons would only put their shoulders to the wheel. There are abundance of lectures and places of chemical instruction in London which they might attend, and a very little attention would enable a young person to muster enough of the subject to detect all sorts of adulteration. I do not say this so much for persons who have allowed their young days to pass without educating themselves in chemistry, but I say that it is the duty of these older persons not to allow the young to have the important study of chemistry systematically excluded from their education; for there is not one school in ten in which they are taught that there are more elements in matter beyond the four elements which the Greeks taught, air, earth, fire, and water. All this kind of knowledge ought to be taught in the present day, and I believe that there would be more classical and mathematical knowledge, if the boys were allowed a relief to their minds in the study of natural science.

I will now proceed to speak shortly of the subjects down on the list. First of the adulterations of the beverages— then respecting the heat-giving foods, starches and sugars, and oils; then the flesh-forming food, and lastly the condiments and spices. Speaking of beverages, I believe on the whole that the great manufacturers, the great producers of wine, beer, or spirits, are not in the habit of adulterating these things. The very extensive analyses by Dr. Hassall show that these substances do not, as a rule, contain anything which has been added for the purposes of adulteration. It is after they are handed to the person to sell by retail that they are adulterated, and probably the most extensively adulterated in this list are the various forms of beer, bitter ale, and stout, which are sold in the public houses. I have before alluded to the practice of adding a little salt, which gives it an increased specific gravity, without taking from its flavour, and enables the publican to add water; and I will just show you how you may detect salt in beer. If I take some salt and put it into a glass, and add water, I shall form a solution of salt, which is the chloride of sodium of the chemists; and the best way of detecting the presence of this salt, is by the addition of some nitrate of silver. Supposing you had beer to analyse, you would have to pass it first through animal charcoal, in order to get rid of the colouring matter, and then on adding a solution of nitrate of silver to the chloride of sodium, you have a precipitate of chloride of silver, a very beautiful thick, white, cloudy precipitate, which there is no mistaking. Now suppose treacle or sugar has been added, you must evaporate the beer to dryness, and then ascertain the quantity of sugar left,—that quantity is about the same in all good brewed ale, stout and porter; and you will find in this museum a quantity of analyses of these beverages, and then by comparison, you will soon see whether sugar has been added to any considerable extent. With regard to pale ales, they have obtained an unenviable notoriety in consequence of the report having got abroad some time ago, that they were adulterated with strychnine, a poison which has the power of producing a contraction of the muscular system, and persons who take a fraction of a grain of it die with frightful convulsions. It seems a frightful thing to think that this should be put into beer for the purpose of making it more palatable; and although it has been found that pure strychnine is not put in, yet the active principle of strychnia is contained in the beans called *nux vomica*, and these beans have been sold for centuries by persons who are not ashamed to call themselves brewers' druggists. The presence of strychnine is easily detected by taking a little piece of bichromate of potash and putting it upon a white plate. By then adding sulphuric acid to it, you produce a coloured liquid which when you add strychnine to it becomes of a very intense and characteristic violet. No other substance but strychnine produces the same colour. You see I have here a beautiful violet colour, which is spreading itself round on this plate, and when seen closely it is exceedingly characteristic of the presence of strychnine. I believe there is no other substance which when in combination with sulphuric acid and bichromate of potash, will produce this beautiful colour. Dr. Hofmann told me at the time when he was investigating the question whether the bitter beers of England contained strychnine, that he could detect the presence of the $\frac{1}{1000}$ part of a grain in a gallon of water. Now I would here remark that supposing the beer were adulterated with nux vomica, the poisonous substance would still be strychnine, and you would obtain the evidence of the strychnine from the nux vomica as from the strychnine itself. There are some other things which are said to be added to beer, but I will not detain you by going over them; salt and sugar are the things mostly used.

With regard to spirits, gin is adulterated with sulphuric acid and sugar, and this is very easily detected by nitrate of baryta, which gives rise to an insoluble white precipitate when it is added to a solution of sulphuric acid. Not only is gin adulterated with sulphuric acid, but vinegar is also adulterated with the same agent. It is added to gin because it tends to give the gin a greater amount of pungency, and in that state it admits of a large amount of dilution, for there is scarcely any of the gin which is sold retail at the public houses which does not contain a certain quantity of sulphuric acid and sugar, and the quantity of alcohol is reduced to very much below the amount contained in the gin as supplied by the distillers. I will say, however, with regard to those gins which the distillers call family gins, or cordial gins, that they consider themselves privileged to add a certain quantity of sugar.

Then, passing from gin, I might say a few words upon wines. We pay a high price for wines, but we cannot detect the adulteration by the means of reagents, as they undergo a more refined process of adulteration. There are chemists, in France more especially, who are able to imitate those *bouquets*, those scents, which no chemical reagents will detect: they are volatile, and will not remain for any length of time. We have heard something lately about publicans' port, which is so coarse and of so horrible a flavour. It is principally composed of cider, brandy and catechu. No persons who are in the habit of drinking port can possibly mistake this for the genuine article. In this case the tannic acid of the catechu may be detected, as also the malic acid of the cider.

Now let me come to the tea, of which there is so large a consumption in this country; and it is of much importance that we should get it pure. But, unfortunately, the English are not the only persons guilty of adulterating this article, for we have it sent from China in a state which is palpably adulterated. We have on the table a tea called by the Chinese Lie tea, and it is not inappropriately named, for there is not any tea in it at all. It is made of sweepings of various kinds, which are treated with prussian blue, and afterwards polished with lamp black, and thus it is made to assume the appearance of green tea. I brought this up from Liverpool, where there are several chests, consigned to this country upon speculation; but the Excise got information of the fact, and will not allow them to be cleared inwards from the dock. At one time there was a treaty going on for the purpose of sending them to America, but whether brother Jonathan has got them yet I do not know. Tea is sometimes adulterated with other leaves which are not poisonous, but they are not tea, and do not contain the active principle of the tea— the *theine* or *caffeine*, for it is the same in both. Now there is no substance which acts in the same way as theine. The only article which can come in competition is this Paraguay tea, which actually does contain the same substance. The Government has taken especial care that none of these things shall be sold as tea, forbidding, in fact, the sale of any kind

of leaf which can be used in the manner of tea. I have here a number of leaves of the tea plant, to show how the other leaves can be detected by comparison. Here is the leaf of the green, and here of the black, which is larger; and here the Assam tea, which is broader, and if you take the leaves, spread them out, and stick them down with gum arabic, you will see the differences between them. Here is the beech leaf, here the poplar leaf, the oak leaf, the willow leaf, and the sloe leaf, all of which have been actually added, and some dried and sold as tea, not as China tea, but for the purpose of making an article called British tea. These were seized, and their sale forbidden. I have here a number of other teas. Here is Swiss tea, prepared with a variety of Alpine plants, but none containing the theine. Here are the leaves of the pine; here the New Jersey, an American tea from a plant allied to the buckthorn. Here is the Lapland tea, and here is a tea which is most extensively used in Mauritius. Where the aromatic substances are used they are used for the sake of their essential oils. Sometimes we find teas adulterated with salts of iron, which give a green colour to the leaf, but the salts of iron are easily detected by putting to a solution a little prussiate of potash, which gives the substance known as prussian blue, at once an indication of the presence of iron. I do not know anything that is more decided, or any experiment more easily performed, than this for the purpose of detecting iron.

I now come to coffee. There is nothing which has been so extensively adulterated as coffee. Here I have a variety of things which are boiled and made into a beverage in the same way as coffee. None of these contain the same active principle as the tea—the theine, which is contained in the coffee leaf as well as in the tea. Here I have the lupin seed, beet-root, parsnips, dandelion-root, acorns, and so on; all are taken and made into their respective substitutes for coffee. They may be, any of them, mixed with coffee, and they thus become adulterations. But of all the substances chicory has been most extensively employed. It is not an uncommon plant in our country; it grows in abundance in the chalk districts. It has a little root which, when dried and roasted, is added to coffee by the French, and by various people on the continent of Europe, and they think it improves the flavour of the coffee. There is no doubt it does decrease the acridity of the coffee, but it is now fraudulently sold to the public as coffee. Now there is one way of finding out this adulteration very easily, not requiring the microscope, or much chemical knowledge. If you take a little coffee and drop it gently on some water, you will see that the coffee swims on the top of the water; but if you drop chicory in the same way you will see it sink rapidly through the water. Now I have here a mixture of chicory and coffee, and you will see that a certain quantity will remain at the top and other portions go to the bottom, so that by putting a little of this into a glass of water you will speedily have a correct idea of the quantity of chicory you have purchased. So by taking a small portion of the suspected coffee and putting it under the microscope you will be able to detect the chicory. The latter has ducts and cells, none of which are found in coffee, and when you see these ducts and cells you may be sure of the presence of chicory in your coffee. But chicory itself is adulterated with starch and other matters, and Dr. Hassall gives us a series of adulterations of chicory, many of which cannot be detected without the aid of the microscope and chemical analysis.]

Cocoa paste, which is prepared from the seeds of the *Theobroma cacao*, a plant which grows in America, sometimes contains red lead, which is put into the cocoa paste for the purpose of giving it a red colour. This is easily detected. If we put a little cocoa paste containing red lead into some water, and dissolve it by the agency of some acid, nitric acid for instance, and then add some iodide of potassium to it, we shall get a beautiful reaction. We immediately detect the salts of lead under whatever form we find them. I will take a clear solution of acetate of lead, and we shall there see the beautiful reaction of the iodide of potassium on this salt. Now I make no doubt you will see the beautiful yellow precipitate. In this way we may detect all the salts of lead. There are other tests which may be employed, but the iodide of potassium is the best. Now not only have we red lead, but starch of various kinds mixed up with the cocoa. The microscope, however, will detect them all.

Passing on from these beverages, I come to the various kinds of food. Here are the heat-giving foods, and I will just call attention to the inferior kinds of starches. Arrow-root, sago, and tapioca are starches. Arrow-root is expensive, sago and tapioca less expensive, consequently we frequently find that arrow-root is adulterated with sago and tapioca. The finest starch may be obtained from these substances, and it is not of very much importance detecting it; but if a person wants arrow-root, and is willing to pay for it, he ought not to have sago, tapioca and potato starch. Here is some from France, called *tous les mois*, of which the grains are very large. West Indian arrow-root is smaller in its grains, and East India arrow-root has smaller grains still, but they all have those peculiar markings on the surface by which it is easy to distinguish them from sago or tapioca. It is more difficult to detect the potato starch when this West Indian and East Indian arrow-root and all these things are mixed up with it. I know of no other means by which starch grains are detected than by the microscope and iodine. You will see, however, that there are other kinds of starch — wheat, barley, and oat; and by study you will soon find that each may be distinguished from the others: the starch of flour, for instance, having that peculiar kind of hexagonal grain.

Passing on from the various starches I come to the saccharine matters. Sugar is not subject to adulteration in the state of white refined sugar. The brown sugar may be moistened, and a very damp sugar is always to be suspected. Sometimes it is very carelessly mixed up with coarser kinds of sugar, and those sugars which have been carelessly kept for a long time are deteriorated. For instance, it is very common to find a little insect called the sugar mite, which is always an indication of the careless way in which the sugar has been kept, but is not evidence of fraudulent adulteration. Now I pass on to the various forms of prepared sugar which are known under the name of comfits, bon-bons, and so on, and sweetmeats of this kind are liable to extensive adulteration. I will just say with regard to white sugar comfits, that they contain flour, sulphate of lime, or daft; and with regard to flour, that which I stated would detect the presence of starch will detect the presence of flour, which contains starch; but with regard to daft, it requires some chemical ingenuity to detect it. Then with regard to these dangerous colours. I do not think that people can detect these things at all, they must apply to the chemist; but the best thing to do if you must give your children sugar, is to give them that from the table which is not adulterated. Take your common refined sugar of the table, which is much better than these coloured sweetmeats. I must say, however, that there are some manufacturers who never put in mineral colours. Here are green, blue, and red vegetable colouring substances, and these are comparatively inert; but, as a matter of precaution, it is better that persons should not take coloured sweetmeats at all. The green are sometimes coloured with arsenite of copper, which is a most deadly poison. If you wish to know whether a green sweetmeat is coloured with this arsenite of copper, you must dissolve it as far as possible in water, and then take the residue which is left and dry it, and then on exposing it to heat in a test tube, you will volatilise the arsenic, which will condense upon the glass, and by the aid of a microscope you will see the crystals. In the same way we detect the vermilion, which is a bisulphide of mercury and poisonous. But these are difficult processes, and can only be satisfactorily carried out by those having a competent knowledge of chemistry. I will, however, put you in the way to do them when you are at home. Now passing on from these more dangerous substances, I will just say that Venetian red and

armenian bole and other similar substances are all more or less objectionable, but not so objectionable as the mercury and the arsenite of copper.

Now I come to those substances which we call flesh-forming foods, and first of all milk. There is every reason to believe that milk is adulterated extensively with water. Here I have some milk from Mr. Hancock's in Brompton, in which you find we have a large quantity of cream; but this I have adulterated myself in these tubes with various proportions of water, showing you that as the quantity of water is increased, the proportion of cream is decreased, and in this way we judge of the extent to which milk has been adulterated with water. By a set of tubes like these you may compare your milk from day to day, with any known standard. There is also another way of judging of the purity of milk, by taking the specific gravity, which answers very well provided the milkman knows no other way of adulterating it except by water. Here I have an instrument marked with water and milk, and the markings between the two indicate different proportions of water and milk. Chalk is said to be sometimes added, but I should say that he is a very unskilful milkman who would add chalk. You can easily detect it by evaporating the milk, incinerating the residue, and then adding vinegar. The moment it comes in contact you will see an effervescence. If you use sulphuric acid instead of vinegar, the effervescence is more intense. Now sugar is sometimes added to milk, and it is said animal matter, sheeps and calves brains are mixed. Well, if you use your microscope skilfully, you will be able to detect those. Those who are going to impose upon the public should know that we can detect every possible adulteration.

I have now come to isinglass, which is adulterated with gelatine, and this is very difficult to detect. You pay 16*s.* per lb. for isinglass and 8*s.* per. lb. for gelatine, and if you pay for isinglass you ought to have it.

Then there are the anchovies with the stupid adulteration of Venetian red. The public will not buy them white, hence the importance of the public knowing what is the true colour of the anchovy and of the colour added to it. Then there are other things substituted for anchovies. I could tell you how to distinguish anchovies from sprats, herrings, or sardines, only one has not time; but by a little attention you can easily detect whether the anchovy is pure.

Ox-tongue has frequently horse's tongue substituted for it. Here is one, and here is a horse tongue cured in the same way; you may know the difference by the spoon-like expansion at the end of the horse's tongue as compared with the ox-tongue.

With respect to preserved meats, here is a thing which is of serious consequence. You have all seen the account of those poor men who have just returned from our Indian empire after fighting our battles, and have been starved on the way home. When recently at Liverpool, I was perfectly astounded at the amount of adulteration going on. On board the ships I saw that which had been shipped as coffee, and which was no coffee at all. Biscuits, utterly unfit to eat, going on board ships; and now we find these preserved meats, which are utterly unfit for food. There ought to be some superintendent to examine these things, so that large quantities of food like this would never pass; so that poor men after all the struggling, striving, and fierce contentions in fighting our battles, should not be starved coming home.

Now we come to the most important articles, bread and flour. We will take the adulteration of the bread with alum. This is not a necessary adulteration. If a baker is going to make bread with *bad* flour, then he supposes that he will make a better looking loaf by using alum, but he does it fraudulently. It is ridiculous for bakers to say that they cannot make bread without using alum, for it is well known that there are thousands and thousands of families in this metropolis who never use baker's bread at all, but good wholesome home-made bread and prefer it. You can sometimes smell which is the alum bread and which is the bread without alum; but that is not always to be done by bread on the table. By taking some aluminised bread and making a solution of it, and then treating the solution by adding hydrochlorate of ammonia and liquor ammonia you throw down a precipitate of alumina. But alum is not easily detected in small quantities, for there are other substances which may be thrown down; but wherever it exists there is no doubt that it is a bad thing. Alum combines with phosphoric acid, and forms a substance which will not dissolve in the stomach. Our bones are made of phosphate of lime, and if the alum deprives the stomach of the phosphoric acid by the introduction of this alum into the bread, and producing compounds which are not easily soluble, we deprive the bones of the nourishment necessary for their development. Bone dust or sulphate of lime mixed in bread will be detected by the microscope.

I must pass over the whole subject of condiments and spices; but there is one article, tobacco, on which I must say a few words. All true tobaccos are covered with little hairs, which can only be detected by the microscope. If you have tobacco cut up ever so small, you do not cut away those little knobbed hairs. Now the leaves used for tobacco have other kinds of hairs, and those are very important in the detection of adulteration and attempted frauds upon the revenue. I hope I have said enough of the importance of this subject. If I have drawn your attention to it it is sufficient; if I have enabled you to form something like an opinion of the value of legislation upon the subject. I have drawn your attention to the fact that a bill is before Parliament for the purpose of appointing a public analyst, to whom you will be able to apply if you suspect an adulteration of your food; but this bill does not go far enough. We should imitate our French neighbours, who seize on the adulterated goods, put the adulterator into prison, and shut up his shop for the term of his imprisonment; and, so long as the man is in prison, his shop has a label upon it stating that it is shut up for adulteration, and that the proprietor is in prison.

I have now to thank you for your attendance in this course, and to announce to you that as you have so kindly attended here on these occasions I am induced to go further, and have undertaken to deliver a course of lectures on the *Animal Product Collection*, and those commence on Tuesday, the 10th of April, to be continued on the five succeeding Tuesdays. The first subject will probably be *Silk and its Dyes*; the next *Wool and Hair*; then *Leather*; the *Manufacture of Leather out of Skins*; the *Manufacture of Glue and Gelatine*; and then will probably follow *Bone and Ivory*, and some remarks on the *Utilisation of Waste*.

SOCIETY OF ARTS, 21 *March* 1860.

W. B. Carpenter, *Esq. M.D., F.R.S. in the Chair.*

On this occasion, Dr. Guy of King's College read a paper on *A New Method of Obtaining Crusts of Arsenic, Arsenious Acid, and other Sublimates*, introducing also various microscopic contrivances to the notice of the Society. Although the paper was certainly a useful one in many points of view, it dealt too much in trivialities to carry any great weight with it, and we cannot help saying that we expected better things from Dr. Guy, who shall now introduce himself.

"As the simple chemical manipulations of which I am about to speak have for their aim to prepare a new class of objects for examination by the lens and microscope, and as the other suggestions to which I have alluded have either grown out of the use of a disc of glass, instead of the usual microscopic slide, or imply the substitution of the one for the other, I will begin by saying a few words about these discs of glass.

"For some years past I have been in the habit of using these discs, and of late especially, on account of their convenience for comparative chemical experiments on the small scale. They are almost necessary for sublimates obtained by heat, and very useful when we wish to obtain a number

of crystalline deposits from solutions at the same time. A great many of these discs can be put under one bell glass, and protected from the intrusive London dust.

"It is a very small matter to speak of, but I may state here, that for these minute chemical operations I find a little instrument, consisting of a spear-shaped piece of common window-glass, mounted in a wooden handle, more convenient than the common glass rod. It acts as a spatula, a coarse filter, and a good drop at the same time. You can put a small quantity of a salt on a piece of window-glass, rub it down with the flat side of this glass spatula, suck up the clear solution by the capillary attraction of the two surfaces of glass, and then drop a large or small drop from the point. I send round a specimen of this very simple chemical tool. I may add that in using the common solutions for these small experiments, I always employ a drop bottle of the form which I now send round. It is a hollow tube drawn to a point, and ground as a stopper into the neck of a bottle; a small hole at the top of this tube converts it into a pipette.

"To the other and more important use of the glass disc, (I mean for obtaining sublimates by heat), I shall allude presently, after I have spoken of the size of the disc, of the mode of adapting it to the microscope, of similar discs made of other materials, and of the art developments to which the use of it has led."

A minute description of the disc itself follows, but our readers may briefly learn that it is about an inch in diameter, or rather less, and cemented in the centre of a piece of wood of the size of an ordinary microscopic slide, having an aperture rather smaller than the glass. Some cells for mounting in fluid were then noticed, those of Messrs. Powells' manufacture being apparently the best, as, although blown, tolerably flat surfaces were retained. Returning to the glass discs, Dr. Guy proceeds:—

"I have said that these discs are serviceable for obtaining chemical sublimates, such as those of metallic arsenic and white arsenic, by heat. I think it quite possible that the habit of using these discs proved suggestive of the very simple modification of the common reduction tube of which I am now to speak.

"For obtaining crystals of arsenious acid, or crusts of arsenic in medico-legal inquiries, the chemist uses a glass tube, of small bore, about three inches long, open at one end and sealed at the other, The tube has the proportions of the test tube I hold in my hand, but the bore is much smaller. This tube should be of German glass. It should be carefully dried before it is used, and the white arsenic, or the mixture of this with charcoal, or of the sulphuret of arsenic with black flux, or the metallic arsenic itself (the result of some previous chemical operation) must be introduced into the tube without soiling its sides. Then, having passed the middle portion of the tube through the flame of the spirit lamp, the flame is applied steadily to the sealed end. The white arsenic in sparkling eight-sided crystals, or the crust of the metal, collects on the sides of the tube about an inch or so above the sealed end.

"This operation is a delicate one, and many minute precautions must be observed in order that it may be satisfactorily performed; and, when the crystals or crusts have been obtained, they are certainly not in a favourable condition for further examination and identification. When, for instance, the crystals of white arsenic are small, they are not readily identified by lens or microscope upon a rounded surface with a sharp curve, and streaked with lines in the length of the tube.

"The number of precautions to be observed, and of fallacies to be guarded against in this mode of procedure, led me to adopt the modification which I am about to describe. In the place of a small reduction tube of green glass, three inches long, I use a larger specimen tube, about three-quarters of an inch long, of common white glass. Into this short tube, from which the moisture is readily driven off, I introduce the white arsenic, the metal, or the mixture. I place the tube in a vertical position, and support it there by letting it fall into a circular hole punched in a sheet of copper, or drilled in a slab of porcelain. This holder may be supported either on a frame attached to the spirit lamp (in which case it should be made to turn over the flame or from it) or on a common retort holder, the spirit lamp being removed at will. The specimen thus adjusted and fixed is then heated to expel the moisture it contains, and the substance to be operated on is dropped into it from the point of a penknife. A disc of common window glass, thin, white, and free from defects or scratches, is then dried and heated in the flame of the lamp, and placed upon the mouth of the tube. On heating its contents, the crystals or crusts are deposited partly on the sides of the tube, and partly, but chiefly, on the flat disc of glass. The coating of the glass disc may then be examined by the lens or microscope, and may be treated, in every respect, as an ordinary microscopic object."

Omitting a few unimportant observations, we find the following more definite statement:—

"I will illustrate the delicacy of this method which I have been describing by an extract from a paper on the subject, published in Dr. Beale's *Archives of Medicine*, No. iii. 1858.

"Four small slips of microscopic glass, each bearing a minute fragment of a crust of arsenic, were weighed in an assay balance, and found to weigh respectively 0·280, 0·230, 0·137, and 0·141 of a grain. The slips having been carefully heated in a small specimen tube three-quarters of an inch long, suspended in a metal holder, yielded distinct circular mists, and lost respectively 0·003, 0·003, 0·001, and 0·001 of a grain; so that two of the crusts weighed each the three hundred and thirtieth part of a grain, and each of the two remaining crusts the thousandth of a grain. Examined by the lens all the mists were found to consist of brilliant detached points, distributed evenly over the surface, which under the microscope could be readily identified as octahedra. Both the mists yielded by the thousandth of a grain could be easily resolved into octahedra, under an eighth power of the microscope, and one of the two, by the successive removals just described, was found to consist of crystals, which could not be less numerous than 250,000,000 to a grain of metallic arsenic, a number which I believe to be greatly under-estimated. Successive experiments with minute quantities of metal, apparently not exceeding the thousandth of a grain in weight, all yielded the same decisive result: so that I feel justified in stating that by this simple method a crust of less than the thousandth of a grain of metallic arsenic may be identified with ease and certainty.

"I shall perhaps commend this plan to the Society if I state that one of the very earliest results accruing from the use of it, was the discovery that metallic arsenic when deposited from its vapour, on cooled surfaces, presents itself in the form of globules. This fact is partly of importance as giving extension and precision to our knowledge of the properties of a most important poisonous substance, and partly as connecting arsenic with other elements with which it was already known to have analogies, I mean sulphur, mercury, and selenium, which, like arsenic, are deposited in a globular form. There are specimens of all these substances under the microscope as well as of some other sublimates obtained in this manner. I need scarcely add that this method gives great facilities for examining the crystals of arsenious acid, which, though usually described (and correctly) as right octahedra, sometimes assume the shape of right prisms, and occasionally, though only rarely (as I have ascertained), the form of the cube."

There remain yet two "new adaptations" to consider, which Dr. Guy respectively designates a "class microscope," and an "illuminated cell." The first consists merely of an ordinary Coddington lens, inserted in a brass eye-piece, screwing into a ring of the same metal, which latter is fixed into a convenient handle; a ledge at the other side of the ring receives the glass disc with the arsenical sublimate, or other microscopical preparation on its surface, and a brass

screw-cap renders the whole secure. As the lens screws easily in or out, its force can be adjusted without trouble. In some varieties of the instrument the cap is furnished with an oblong slot, so that objects can be examined mounted either upon a disc, or on a slide of the usual dimensions. The "illuminated cell" is for opaque objects only, and is made by pressing a circular piece of tinsel having a central perforator into a concave form, thus producing in fact a small Lieberkühn for each object, an arrangement which seemed to answer very well. The doctor concluded his paper by directing attention to the various instruments and specimens exhibited. Among the former we noticed a contrivance intended to be used either as a microscope or telescope, for the capabilities of which Mr. Matthews of Lincoln's Inn is responsible. Dr. Guy's "class lens" is manufactured by Mr. Baker of Holborn.

The Chairman, in pointing out the advantages accruing from Dr. Guy's method of obtaining sublimates, said that with the old reduction tube, where the deposit was necessarily of a cylindrical form, nothing more powerful than a hand lens could be employed for examining it, whereas upon the flat surface of a glass disc, a high power could readily be applied. While upon the subject, he would name another application of the microscope to the detection of minute quantities of chemical substances, viz. that of Dr. Richardson, who had ascertained the presence of ammonia in the breath of animals by its means. The plan adopted by him was to cause the breath to pass along a small trumpet-shaped tube, having a bulb near its larger extremity, containing hydrochloric acid. Consequently the ammonia in the breath was converted into chloride of ammonium, and deposited in excessively small crystals upon a slip of glass placed across the mouth of the tube. He only mentioned this fact to show the value of the application of the microscope where very minute quantities of substances were concerned. He personally did not find the glass discs so handy as the ordinary slides, but saw many advantages in Dr. Guy's system. The flat surface bottles would, he thought, be most useful in museums. With regard to the "illuminated cell," he might mention that some specimens prepared in a somewhat similar manner by Lieberkühn himself, were in the museum of the College of Surgeons. The adaptation of a piece of tinsel was a great simplification.

Dr. Letheby had great pleasure in stating that Dr. Guy's method of recognising arsenic was employed in his own laboratory, and he felt thankful for its introduction. He traced the progress of toxicological research from the trial of Donald in 1815 up to the present time. A little while before that, as described by Hahnemann, 10 grains of arsenic were required to make the metallic test satisfactory in a court of law. Afterwards Dr. Black improved the process, and could detect the poison if he had *one* grain to operate upon. It was thought a marvel of toxicological skill when Dr. Chistison said he only required the 16th of a grain, but that evening they were told how to trace the presence of the 250,000,000th of a grain of arsenic! He also enlarged upon the uses of the microscope in detecting the organic poisons by the identification of their crystals, and considered that the process of Dr. Guy would greatly elucidate that branch of the subject.

Mr. Wentworth Scott said that it was of great importance that the surface for receiving arsenical deposits should not only be flat, but should also possess a tint suitable for showing microscopic crystals well by reflected and transmitted light. He submitted for inspection a specimen of the slides he had had specially prepared for this and other purposes, which were coated on one side with a film of "opal glass," both surfaces being highly polished. They answered so well that he never employed porcelain. A metallic deposit was admirably shown by reflected light upon these glasses, while crystals of arsenious acid were best seen by sending the light through the opal, all inconveniences arising from the great refractive power of many objects being avoided by its use. He wished to say a word against the ordinary form of Marsh's apparatus as supplied by philosophical instrument makers, which he considered unfit for any important researches, the bulbs, generally, not more than an inch and a quarter in diameter, being far too small. He preferred to use a small Wolffe's bottle, fitted with a bulb-tube. He thought that one phenomenon which he had observed in using this process had not been noticed in any work on the subject, and that was, when the suspected animal matter, more especially liver, perhaps, had not been completely oxidised, a deposit much resembling arsenic (or antimony) was often obtained, consisting really of carbon, or some peculiar carbonous matter with a metallic lustre, and requiring a microscope to detect it. He had known many analysts deceived by this, and although, of course, no one should be content with a single test, he thought that the point should be brought forward more prominently in our schools of science than it was. He employed sulphuric acid and bichromate of potassa for oxidising with entire success. He could corroborate the Chairman's remarks upon the presence of ammonia in the breath, having had the honour of being intimately associated with Dr. Richardson in his experiments, and had detected very minute quantities, the ·008 of a grain, and even less, of ammonia in the breath and blood of animals.

In compliance with the Chairman's request, Dr. Letheby explained his modification of Marsh's process, in which the great delicacy of the latter is combined with the certainty and facility of Reinsch's method. He first slightly acidulates the suspected liquid with nitric acid, raises it nearly to the boiling point, and then introduces some pieces of zinc. If arsenic is present the zinc becomes coated with it in a few minutes, when it may be removed, washed, and used in the ordinary way for the generation of arseniuretted hydrogen. Both Marsh's and Reinsch's tests were open to one great objection, namely, that they failed to show the *quantity* of poison found.

Dr. Thudichum made a speech of some length, the chief object of which appeared to be to throw cold water upon the sublimation tube and discs of Dr. Guy, and to show that the microscope was quite useless in analytical researches. He described in detail all the usual methods for separating arsenic, including those of Wöhler, Fresenius, Rose, Bloxam, &c. but which we will not repeat here for fear of wearying our readers. He would use (Dr. Thudichum said) the very example adduced by the Chairman in favour of the microscope, as a proof of its fallacy. Crystals had no doubt sometimes been obtained from the breath by method before named, but whether they consisted of chloride of ammonium, or of the many hundred substituted ammonias, or even contained any ammonium at all, there was no evidence to show, the appearance of crystals of all the Amine bases being nearly alike. He considered that Dr. Guy's method would offer no advantages to the medico-legal chemist.

Mr. Wentworth Scott referred Dr. Thudichum to Dr. Richardson's essay on the blood, wherein it was stated that the presence of no particular ammonia had been determined; all that was stated being that the solubility of the fibrine during life was due to an exceedingly minute quantity of *an* ammonia of some kind. Every chemist was aware of the immense number of ammonias that existed, chiefly eliminated by the splendid researches of Hofmann, aud that the crystals of their chlorides greatly resembled each other, but none could mistake the chlorine compound of an ammonia for the chloride of anything else. He believed that a special ammonia existed in the blood of each distinct animal or class of animals, and trusted that the point might ere long be determined. He differed with Dr. Thudichum in relation to the microscope, which he considered no chemist could dispense with. As regards the processes named for the detection of arsenic by the last speaker, he thought them too complicated where only small quantities could be expected, and would mention in conclusion, that if the organic matter to be examined were dried at a very low temperature and then treated with pure benzole the fatty matter could be extracted, and the oxidation tendered comparatively easy.

After a few remarks from Dr. Guy, who also differed entirely from Dr. Thudichum, the Chairman proposed a vote of thanks to the author of the paper, which having been passed, the meeting then adjourned.

The Society of Arts' Annual Exhibition of Recent Inventions will be opened upon the 9th of April. A series of Notices of the Exhibition, from the pen of a member of the society, will *shortly appear* in the Chemical News.

NOTICES OF PATENTS.

Improvements in the Manufacture of Steel and Wrought Iron, by W. H. Nevill.

Every one is aware of Bessemer's method of decarbonising cast iron, by forcing air through it at the fusing point. In this case the temperature rises immensely owing to the heat produced by the combustion of the carbon and part of the iron. Mr. Nevill instead of forcing air through the melted metal, causes the latter to fall from a height upon a cone; in this way the exposure to the air is obtained upon which he relies to remove the excess of carbon. He paves the floor with cast iron plates, and in the centre places a cone 18 inches diameter and 9 inches high. It is mounted on a standard which raises it to 3 feet 6 inches above the floor. The exit for the metal is so arranged that it falls directly on the cone, which scatters it, and allows it to fall on the floor in a purified state. The spot on which it falls is enclosed, so as to retain it in its place.

The plan is simple, ingenious, and does not appear to contain any obvious sources of error. How is the mass broken up for working into shape or subsequent fusing?

Method of obtaining Potash and other Products from Suint, by Edmé Jules Maumené *and* Victor Rogelet.

"Suint" is the greasy matter found in the skin and hair of sheep. The patentees find it to be the potash salt of some organic acid or mixture of acids. The chief peculiarity of it is the fact that the potash is almost absolutely free from other metallic oxides. The suint is washed with cold water which does not touch the grease, but only dissolves the "suintate of potash." The latter when evaporated has the appearance of baked molasses. It is calcined in close vessels and yields the usual products of the distinctive distillation of nitrogenised organic matters, namely, tar, ammoniacal water and gases. The carbonate of potash mixed with charcoal is then lixiviated, and the solution evaporated to dryness. Any sulphide formed in the first evaporation (owing to the decomposition of sulphates by the free carbon) may be removed by calcining in a reverberatory furnace or stirring the solution with a little white lead.

The wool washed by the patentee's process is much whiter than when scoured in the usual manner.

"One thousand pounds of raw wool, of whatever country, yield generally from one hundred and forty to one hundred and eighty pounds of dry suintate (or salts) of potash, soluble in water. This "suintate" produces nearly fifty per cent. of carbonate of potash, that is to say, from seventy to ninety pounds, including the chloride and sulphate, which together, barely amounts to five or six pounds."

The patentees claim all the products formed. The carbon remaining after calcination is said to be suitable for pigments. They carefully prepare the ammoniacal salts and tar for sale, as also the chlorides and sulphates, which they separate by crystallisation from the solution of the crude carbonate of potash. They also collect the fatty substances of the wool. Owing to the extreme purity of the potash producible by their process, they claim every substance made from it, even saltpetre and potassium. This appears to us to be a most valuable patent. Every claimant is aware that the potash of commerce (and its salts) are liable to contamination with soda and other impurities. Now there are numerous operations, especially in scientific chemistry, where the absence of soda is of importance, and this process, as opening up a method of supplying a want greatly felt, is especially valuable. Moreover, in wool countries the quantity of suint will be sufficient to enable considerable sums of money to be annually obtained from an otherwise useless product. We think, however, that there was no great necessity for claiming the preparation of nitre and potassium from the suint potashes.

CORRESPONDENCE.

Dr. Guy's Lecture on Arsenious Acid.

To the Editor of the Chemical News.

Sir,—From a notice on the cover of the present number, I perceive that in next week's Chemical News you intend to print the paper read at the Society of Arts, on Wednesday evening last, March 21, by Dr. Guy, *On a New Method of obtaining Arsenical and other Sublimates, for Microscopic Examination.* In doing so, I trust you will intimate to our provincial and continental brethren, that you do not publish it as a fair specimen of the practical chemistry of the London laboratories.

All that Dr. Guy proposes to do is done in a far better way by simply fixing a small round piece of glass, such as a microscopic covering glass, on to the end of a glass rod, or into a holder improvised out of a piece of platinum wire, and passing it as far as necessary down a common test-tube, at the bottom of which is the substance containing the volatile matter. Heat being applied, any portion of the sublimate that escapes condensation on the little piece of glass will probably condense on the upper and cooler part of the test-tube, and not be altogether lost, as must inevitably be the case in Dr. Guy's arrangement.—I am, &c.

Tyro.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Artificial Production of Minerals.—M. Debray[1] has recently succeeded in preparing artificially several crystallised phosphates and arseniates identical in form and composition with the natural mineral. When an insoluble carbonate is digested with an excess of phosphoric or arsenic acid, the carbonate is generally changed into a crystallised phosphate or arseniate. The water of hydration varies according to the temperature. At the ordinary temperature carbonate of lime and phosphoric acid give a phosphate of the composition $2CaOHOPO_5 + 4HO$. At 212° the compound $2CaOHOPO_5$ is obtained. At the same temperatures exactly corresponding compounds are formed with arsenic acid and carbonate of lime. The compound $2CaORsO_54HO$ is found native and is known under the name of Baïdingerite.

When the acid liquid in which the carbonate has been digested is decanted and heated, other equally well crystallised compounds are obtained. The solution of arseniate o lime heated to 158° gives $2CaOAsO_53HO$: heated to 212 it yields the compound $2CaOAsO_5HO$. Phosphates of zinc copper, and manganese, and arseniate of copper can be pro cured in the same way.

Insoluble phosphates and carbonates of lime, magnesia, &c act on a metallic nitrate and sulphate, and produce crystallised compounds, whose composition varies according to the temperature at which they are formed. At a little over 212° Debray obtained the phosphate $4CuOPO_5HO$ (libethenite), and the arseniate $4CuOAsO_5HO$ (olivenite).

Crystallised double phosphates are formed when acid

[1] *Comptes-Rendus.*

solutions of phosphates are mixed with metallic solutions. Acid phosphate of copper and nitrate of uranium gave the double phosphate of copper and uranium, chalcolete.

II. ORGANIC CHEMISTRY.

A New Mode of Substitution, and the Formation of Iodobenzoic, Iodotoluylic, and Iodoanisic Acids, by M. P. Griess.—M. Griess[2] has before announced the existence of a new class of azotised acids, formed by the acid of nitrous acid on the amid acids of the benzoic group. By treating amidobenzoic acid with nitrous gas he obtained an acid $C_{28}H_{11}N_3O_8 + 3HO$. He now describes the action of acids upon this new body. On treating it with strong hydrochloric acid it becomes hot and nitrogen is disengaged. The addition of water to the evaporated liquid separates reddish flocculi, which by crystallisation from alcohol furnish chlorobenzoic acid. By continuing the evaporation the hydrochlorate of the amido-acid is obtained:

$$C_{28}H_{11}N_3O_8 + H_2Cl_2 = \underbrace{C_{14}H_7NO_4.HCl}_{\text{Hydrochlorate of benzamic acid.}} + \underbrace{C_{14}(H_5Cl)O_4}_{\text{Chlorobenzoic acid.}} + N_2.$$

Idobenzoic Acid, $C_{14}(H_5I)O_4$, is formed on treating the nitro-acid with hydriodic acid. It is very slightly soluble in water, but dissolves freely in alcohol and ether. It crystallises in long scales. In contact with fuming nitric acid it is changed into nitroiodobenzoic acid. Its silver salt forms an amorphous white precipitate.

Idotoluylic Acid, $C_{16}(H_7I)O_4$. This acid is formed with the nitro-derivative of the toluic series, as iodobenzoic acid is in the former case. It crystallises in nacreous scales, is slightly soluble in water, and freely soluble in alcohol and ether.

Iodoanisic Acid, $C_{16}(H_7I)O_6$. Its mode of formation is the same as the preceding. It crystallises in fine white needles, insoluble in water, but very soluble in alcohol and ether.

Glycolic Ethers.—M. Lourenço[3] shows that these ethers may be easily obtained by heating in a sealed tube to about 200° C. equivalent proportions of the acid and glycol. In this way he has made (as Mr. Simpson had before) the *mono-acetic glycol* obtained in other ways by Mr. Atkinson.

Monobutyric Glycol is a colourless oily liquid, insoluble in water, soluble in alcohol and ether, having an odour like butyric acid. It boils at 220°.

Monovaleric Glycol is also a colourless oily liquid, insoluble in water, and soluble in alcohol and ether. It smells like valeric acid. The boiling point is about 240°.

Diacetic and *divaleric* glycols are formed by heating glycol with an excess of the acids. The latter boils about 250° C.

Mixed Ethers may be formed by treating as above an ether of glycol with one acid radical by another acid. M. Lourenço has obtained acetobutyric and acetovaleric glycol in this way. The latter is an oily, colourless, neutral liquid, soluble in alcohol and in ether, and boiling about 230°.

Action of Organic Chlorides on Glycol.—M. Lourenço[4] also notices that the chlorides of acetyle and butyryle act with great energy on glycol at the ordinary temperatures. If, however, they be mixed in a cooled tube, it may be sealed before the action begins. Chloride of acetyle and glycol heated in a tube for some hours gave water and the *acetohydrochloric glycol* of Mr. Simpson.

III. CHEMICAL ANALYSIS.

Detection of Peroxide of Lead in Litharge.—Stein[5] heats the litharge in a test tube with chloride of sodium and bisulphate of potash, and introduces into the tube a slip of paper coloured with a solution of indigo. If any peroxide be present chlorine is disengaged and bleaches the paper.

Platinising Glass and Porcelain.—Every one who has experimented with an extemporised Marsh's apparatus has found that after the gas has burned a short time the glass tube has become fused and the aperture closed. Herr Dullo[6] says this may be prevented by platinising the extremity of the tube. He draws out the tube, files it to make it a little rough, and then dips it into a strongish solution of bichloride of platinum, so as to take up a drop or so. He then carefully heats the point until it acquires a beautiful metallic lustre. By repeating this four or five times a good coating of platinum is obtained both outside and inside.

In the same way the author platinises porcelain crucibles, using of course unglazed ones for the purpose.

IV. TECHNICAL CHEMISTRY.

Manufacture of Beet-root Sugar.—Various methods have been proposed for removing the lime dissolved in the syrup when that agent has been used in the purification of the juice. Carbonic, pectic, oxalic, phosphoric, and tannic acids, and soap have been proposed at different times; and now M. R. Wagner[7] recommends oleic acid. When this is agitated with saccharate of lime, the latter is quickly removed; but unfortunately as the oleic acid is generally contaminated with some volatile acids (capric and caproic) the sugar acquires a rancid taste which is very difficult to remove. Melted stearic acid will answer the same purpose; and the soap formed being decomposed by a strong acid, the stearic acid can be recovered and used again.

The author also proposes to use gelatinous silica.

[2] *Comptes-Rendus*, t. xlix. p. 900.
[3] *Ibid.* t. l.
[4] *Ibid.*
[5] *Polytech. Centralblatt*, s. 1626, 1859.
[6] *Journal für Praktisch. Chem.* Bd. lxxviii. s. 367.
[7] *Polytech. Journ.* t. cliii. p. 377.

SCIENTIFIC NOTES AND QUERIES.

Electrical Decomposition of Compounds of Nitrogen.—Sir,—Professor Faraday, at p. 217 of his *Lectures on the Non-Metallic Elements*, remarks, as one of the peculiarities of nitrogen, that "electricity determines no liberation of nitrogen from any of its compounds." Mr. Grove, at p. 93 of his *Lectures on the Correlation of Physical Forces*, asserts that "ammonia, protoxide of nitrogen, deutoxide of nitrogen, &c. are decomposed by the action of the discharge." I shall feel thankful by being informed which of these contradictory statements is correct.—*E. G.*

Apparatus for keeping a Liquid at a constant Level.—Sir,—Will Mr. *John Tillman* be so kind as to inform a student of chemistry in what the apparatus devised by him for keeping up a constant level in a fluid differs from Gay-Lussac's washing apparatus, described in every work on chemistry which touches on manipulation.—*B. X.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Excelsior.—1. An alloy of 8 parts bismuth, 5 of lead, and 3 of tin, fuses a little below 212°. 2. There is no rule that we know of. 3. See p. 194.

A Constant Reader.—The course of study extends over five years; three of which must be spent in attending hospitals and classes. The candidates are examined in anatomy and physiology and surgery.

W. P. (Oldham)—1. The effects of the alkaloids could not be at all controlled by the mixture you mentioned. 2. To make caustic soda take 2 parts of quicklime and 10 parts of common soda, and water according to the strength of the solution required. 3. It can only be procured direct from America. We do not know the price.

G. B. (Nottingham)—The best account at present is to be found in Gmelin's *Chemistry*, vol. xi. We shall have papers on the subject soon.

J. C.—It would be impossible to say without experimenting.

E. J.—Sulphide of calcium made into a paste with water is the most harmless preparation to use. It must be washed off in a quarter of an hour.

B. B.—Received.

J. J.—Declined with thanks.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publisher, at the Office, 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Notes on Boiling-Points, by ARTHUR H. CHURCH, *F.C.S.*

ONE great difficulty besets all attempts at drawing correct conclusions concerning the boiling-points of homologues, isomers, metamers, &c., the determination of boiling-points being of necessity referred to an arbitrary barometric pressure. The alteration in boiling-point, consequent upon an alteration of pressure, is by no means the same for all liquids. Then, too, the determination is often made somewhat carelessly: perhaps the pressure is not noted at all, or the thermometer is incorrect, or the presence of moisture is not guarded against; or maybe the substance itself is not pure; finally, oxidation of the substance may occur from the action of the atmospheric air in the heated vessel. From time to time, however, some very interesting relations between the boiling-points of various organic substances have been pointed out, chiefly by Kopp. One thing is certain, that under a pressure of 760 mm. the elevation in boiling-point for an increment of ΘH_2 is not the same for all homologous series, and it seems probable that it is not of equal value in different parts of the same series.

It is remarkable that the substitution of 1 eq. of methyle for the 1 eq. of basic hydrogen in the series of acids of which formic acid is the first member, *reduces* the boiling-point by about 63° C. for this substitution is really the addition of ΘH_2. If for the basic hydrogen of formic acid we substitute ethyle, the boiling-point is lowered 44°·7, or 63°—18°·3. A similar relation may be observed between water (*hydric acid*, or hydrate of hydrogen) and its ethyle derivatives, alcohol and ether:

	Boiling-point.	Difference.
Water, H, HΘ	100°·0	
		21°·5
Alcohol, Θ_2H_5, HΘ	78°·5	
		21°·5 × 2
Ether, Θ_2H_5, $\Theta_2H_5\Theta$	35°·5	

Here the substitution of Θ_2H_5 for H in water (really the addition of $2\Theta H_2$), reduces the boiling-point 21°·5, while the substitution of a second eq. of H. by a second eq. of Θ_2H_5, which is the introduction of another $2\Theta H_2$, lowers the boiling-point by twice that amount. Also, where 1 eq. of H in hydrate of ethyle is replaced by methyle, the boiling-point is lowered about 63°. Replacement of the H of HCl, and of NH_3, types of other classes of chemical compounds by organic groups, instead of reducing the boiling-point raises it.

On careful collation of all the boiling-points of organic substances which have been accurately determined, it seems that a difference in composition of ΘH_2, however caused, is indicated in homologues by a difference of boiling-point which seldom or never exceeds 27, and is scarcely ever less than 9 degrees centigrade. Whatever the reason, the actual numbers for the various series exhibit considerable fluctuations, as the following instances show:—

	Difference.
Nitrites of methyl and its homologues	26°·5
Oxides „ „	24·5
Radicals „ „	23·0 and 20°
Hydrates „ „	23·0 and 14°
Cyanides „ „	21·3 and 21°
Nitrates „ „	21·0
Formiates „ „	20·4
Acetates „ „	19·0
Butyrates „ „	17·5
Valerates „ „	17·0
Oxalates „ „	12·0
Acids of the formic series	20°·0; 19°·0; 18·5
Anhydrides „	12·5
Benzole series	22·3

But it is perhaps among the boiling-points of compounds containing nitrogen, and especially among the organic bases, that we find the most singular relations. On comparing the cyanides of ethyle, butyle and amyle, we find that the difference in boiling-point for ΘH_2 is as much as 21°:—

		Boiling-point.	Difference.
Cyanides of	Ethyle	82°	21°·3 × 3
	Amyle	146°	
	Butyle	125°	21°·0
	Amyle	146°	

And in the series of bases of which pyridine is the first term nearly the same values for ΘH_2 are obtained.

	Boiling-point.	Difference.
Pyridine	115°	
		18°
Picoline	133°	
		22°
Lutidine	155°	
		23°
Collidine	178°	
		20°
Parvoline	198°	

The mean here is about 20°7. But in the aniline series, which is isomeric with that of pyridine, the highest value assignable to ΘH_2 is 16°, and if reliance may be placed upon the boiling-points given as those of the higher terms of the series, the increment as we ascend is reduced as low as 12°. As aniline and its homologues constitute the starting-point of numerous other homologous series, such as those of methyl-aniline, methyl-toluidine, &c. we may expect that the boiling-points of the various members of these series, if accurately determined, will afford us some light as to the influence on the boiling-point of the various forms in which the increment ΘH_2 has been introduced. On comparing the methyle and ethyle derivatives of aniline and toluidine, and also of piperidine, a tolerably regular increment of 11° for each addition of ΘH_2 is observable:—

	Boiling-point.	Difference.
Aniline	182°	
		11°
Methylaniline	193°	
		11°
Ethylaniline	204°	
		11°
Propylaniline	215°	
Toluidine	198°	
		10°
Methyltoluidine	208°	
		10°·5
Ethyltoluidine	218°·5	

	Boiling-point.	Difference.
Piperidine	106°	11°
Methylpiperidine	117°	11°
Ethylpiperidine	128°	

In the case of ethylamine, diethylamine and triethylamine, the higher difference of 19° is caused by each increment of ΘH_2.

	Boiling-point.	Difference.
Ethylamine	19°	38° = 19° × 2
Diethylamine	57°	38° = 19° × 2
Triethylamine	95°	

The accuracy of several of the determinations given above is but doubtful: if, for instance, 95° be the correct boiling-point of triethylamine, it seems improbable that the boiling-point 91°, assigned to trimethylamine, or the number 95° for amylamine, can be true. Again, the cyanide of ethyle is said to boil but 5° higher than the cyanide of methyle, while the difference in boiling-point in all the other well-known terms of the same series is 21°. For further deductions, especially as to the influence of Θ and H on the boiling-point, we must wait till we have obtained more accurate and more abundant data. As yet there is scarcely anything to add to the speculations and calculations of Kopp, Gerhardt and Schröder on this subject.

On Osmious Acid and the position of Osmium in the list of Elements, by J. W. Mallet, *Professor of Chemistry University of Alabama.*[1]

Of the five oxides of osmium stated to exist, the second and fourth have not been isolated, although compounds containing them are known. While preparing osmium from some black platinum residues, the author obtained a substance which there is some reason to believe may be osmious acid, OsO_3, mixed indeed with osmic acid, but still permitting certain of its properties to be observed.

The residues were fused in an iron crucible with three times their weight of nitre. The fused cake, while still warm, was broken up and placed in a flask fitted with a long tube bent at right angles, and a funnel tube, the extremity of which was drawn to a small bore, and reached to the bottom of the flask. The bent tube was well cooled, and strong oil of vitriol was cautiously added, a few drops at a time, through the funnel. The acid produced intense heat on coming in contact with the cake of potash salt, and oily drops of a bright yellow colour soon began to appear in the cooled tube. These slowly congealed to a solid resembling unbleached beeswax. In time a considerable quantity of this yellow substance collected in the tubes and receiver. By gentle heating the whole was collected in the receiver and united under water to a single mass. Towards the end of the distillation *colourless* needles and fused drops of the well-known osmic acid came over, and doubtless a considerable proportion of the yellow mass in the recciver consisted of the same. Thinking the yellow colour was due to some impurity, the author cautiously resublimed the product, but it collected of the same tint as before. It appeared more fusible and volatile than osmic acid. The water in which it was fused acquired a bright yellow colour and gave off fumes, the odour of which seemed somewhat different from that of osmic acid, but which irritated the eyes so insufferably that it was scarcely possible to finish the work and put it up for preservation. It was, however, removed in a single cake, and sealed up in a perfectly clean glass tube. The water in which it had been fused, gave with caustic potash a very dark brown-red colour; such a tint as would probably result from a mixture of the red *osmite* of potash, discovered by Frémy, with the orange-brown *osmiate*.

The sealed tube containing the cake of yellow acid was exposed to the direct rays of the sun, when the acid immediately began to sublime upon the sides of the tube, not in long needles and prismatic crystals, like osmic acid, but in feathery crusts like sal-ammoniac, which under the lens had the appearance of minute octahedrons grouped together. The colour was still bright yellow; but in a short time it began to turn black, and in 24 hours the whole inner surface of the tube was black and opaque. Pure osmic acid exposed in the same way for weeks did not change. It is easy to imagine the cause of the change if the yellow acid be the teroxide mixed with osmic acid. The teroxide probably broke up into osmic acid and one of the lower oxides, or perhaps osmium itself.

In order to ascertain, if possible, what change had taken place, the tube was opened after three months. The black and partially friable contents readily sublimed, and condensed in yellowish needles, leaving a little black powder behind. The inner surface of the tube was coated with a thin crust of a black colour and considerable lustre, which experiments seemed to show was the protoxide.

What the yellow substance really was it requires further investigation to show. The author quotes Thompson, who observes that osmic acid sometimes has a tint of yellow; and Berzelius, who remarked that when sulphurous acid was added to a solution of osmic acid, the latter passed through various shades of colour, *yellow*, orange-yellow, brown, &c. which he attributed to the successive formation of sulphates of the binoxide, sesquioxide, &c.; but the author asks, may not the first step in the reduction have been osmious acid, giving the yellow colour?

The properties of osmium and its compounds are very remarkable, and render it a matter of no little interest to trace the analogies of this rare substance, and fix its place among the other elements. Reviewing the positions assigned to osmium by former writers, the author agrees with Dana, who places osmium in the "arsenic section," including nitrogen, phosphorus, arsenic, antimony, bismuth, and tellurium. The last named is doubtful, and ought rather, perhaps, to be placed with sulphur and selenium.

In a memoir published by Dumas on the numerical relations subsisting among the atomic weights of the elements, the arsenic series is thus given:

	Atomic weights.
Nitrogen	14
Phosphorus	14 + 17 = 31
Arsenic	14 + 17 + 44 = 75
Antimony	14 + 17 + 88 = 119
Bismuth	14 + 17 + 176 = 207

If osmium and ruthenium be introduced into the group, the latter must stand between phosphorus and arsenic, which osmium will follow:

	Atomic weights.
Ruthenium	14 + 17 + 22 = 53
Arsenic	14 + 17 + 44 = 75
Osmium	14 + 17 + 66 = 97

Besides these numerical relations, there is a clear resemblance running through the formulæ and properties of the oxides of these metals. On comparing ruthenium and osmium with the recognised members of the arsenic group, we find that both metals form protoxides, which

[1] Abridged from *American Journal of Science and Arts.*

are feeble bases, as are probably the corresponding compounds of the other members of the group. We next meet with sesquioxides, whose formulæ are exceptional in the series; but for neither metal has this grade of oxidation been obtained in the free state and pure, and in the case of osmium its existence may be gravely doubted. The binoxide of osmium is a feeble base, as is the binoxide of ruthenium. The teroxide of osmium is the body supposed to have been isolated in the experiment described at the beginning of this paper. Its position as a feeble acid, capable, however, under certain circumstances, of playing the part of a base, its fusibility and volatility (greater, apparently, than those of osmic acid, as nitrous acid is more fusible and volatile than hyponitric), its probable crystallisation in octahedrons of the regular system, in which arsenious acid and teroxide of antimony are also found, all tend to indicate homology with the other teroxides of the arsenic group. Just as we find hyponitric acid (NO_4) and antimonious acid (SbO_4) to be the most stable of the higher oxides of nitrogen and antimony, so the well known osmic acid (OsO_4) seems to be the grade of oxidation which osmium most readily assumes when not in contact with bases.

The tendency throughout the arsenic group is manifestly to the production of the acid compounds MO_3 and MO_5, the former the more fusible and volatile body, the latter the stronger acid. In addition we have some cases of the protoxide (MO) a feeble base, and the binoxide (MO_2) a body of still more feebly basic properties, verging upon the acids. All other grades of oxidation, as far as they exist at all, may perhaps be correctly viewed as compounds of the preceding *inter se*. The stability of the oxide (MO_4) in a separate state is remarkable—its formula is one of rare occurrence.

The affinity of all the elements of the group for oxygen is remarkable; it is so in the case of osmium, which, like arsenic and antimony, is clearly able to take up oxygen at common temperatures. Roasting at a red heat in a current of air, affords, as is known, a good method of obtaining osmic acid from platinum residues, just as by a similar process arsenious acid is prepared from native arseniurets.

It would be a matter of much interest to compare osmium with its supposed homologues, under circumstances in which we should expect it to play an electronegative part. Frémy has announced his belief in the existence of an *osmiuretted* hydrogen, but such a compound has not been isolated and described. Compounds of the metal with ethyl, methyl, &c. would be well worth examination, and it is not unlikely that such might be prepared.

The specific heat of osmium, as far as its value as a physical character goes, *opposes* the introduction of this element into the arsenic group. It has been determined by Regnault =·03063; multiplying by the equivalent 97, we have the product 2·9711, thus placing osmium in the list of elements (including the majority) for which the product of sp. wt. by at. wt. is nearly 3, while for phosphorus, arsenic, antimony, and bismuth the product thus obtained is twice as great, or about 6. In this respect, however, osmium probably resembles nitrogen.

Osmium is placed by Faraday, with some doubt, in the paramagnetic class; the metal and its protoxide were found to act feebly in this sense, while pure osmic acid is said to have shown itself clearly *diamagnetic*. The strongly diamagnetic character of phosphorus, antimony, and bismuth would render a re-examination of this point interesting.

Reviewing the united physical and chemical characters of osmium, and comparing them with those of the generally recognised members of the arsenic group, the author thinks he is justified in concluding that it is with them this metal should be classed in a natural arrangement of the elements.

TECHNICAL CHEMISTRY.

The Specific Gravity of Mixtures of Alcohol and Water.[1]

After three series of determinations which have occupied him more than a year, H. von Baumhauer has arrived at the conviction that the specific gravities of mixtures of alcohol and water as determined by Gilpin, Löwitz and Gay-Lussac are very incorrect. In the first series of experiments the mixtures were made by volume, but as these gave results so different from those generally received, the author repeated his experiments with mixtures made by weight as well as by measure. These, however, only confirmed the results previously obtained. The author started with absolute alcohol having a sp. gr. of 0·7946 at 59° F. In the second series alcohol from another source was used which had the sp. gr. 0·7947 at the same temperature. The water used in the experiments was distilled and carefully deprived of air. After corrections for slight mistakes the results obtained were as follows:—

Alcohol in 100 of the mixture.	1st series.	2nd series.
100	0·7939	0·7940
95	0·8119	0·8121
90	0·8283	0·8283
85	0·8438	0·8432
80	0·8576	0·8572
75	0·8708	0·8708
70	0·8837	0·8938
65	0·8959	0·8963
60	0·9079	0·9081
55	0·9193	0·9196
50	0·9301	0·9302
45	0·9394	0·9400
40	0·9485	0·9491
35	0·9567	0·9569
30	0·9635	0·9636
25	0·9692	0·9696
20	0·9746	0·9747
15	0·9799	0·9800
10	0·9855	0·9855
5	0·9919	0·9918
0	0·9991	0·9991

PHARMACY, TOXICOLOGY, &c.

On the Detection and Estimation of Phosphorus and Phosphorous Acid in cases of Poisoning, by Prof. Scheerer.[2]

In several communications on poisoning by phosphorus, Professor Scheerer confirms the extraordinarily poisonous nature of that body. In the case of a woman to whom the composition from 30 or 40 lucifer matches was administered in milk, death ensued within 48 hours. The amount of phosphorus in that quantity of the paste can hardly have exceeded 0·5 of a grain.

In every case brought under the author's notice, it seemed desirable to look for the presence of unoxidised

[1] *Comptes-Rendus*, t. l. p. 591.
[2] *Annalen der Chemie und Pharmacie*, Bd. cxii. s. 214.

phosphorus. For this purpose the process indicated by Mitscherlich was adopted with the modification that all the air was expelled from the apparatus and replaced with carbonic acid gas.

This was effected in a very simple way, by dropping a small piece of chalk into the mixture of sulphuric acid and the suspected matters (contents of the stomach, food coffee, &c.), and making the tube of the retort to dip into distilled water in the receiver.

In this way luminous vapours are not obtained in the distillation tube, as is the case when carbonic acid is not used; but instead of this the greater part of the phosphorus in the mixture is distilled unchanged (only a small part being transformed into phosphorous acid) both of which are condensed in the water contained in the receiver. This water becomes strongly luminous when gently agitated in a dark room, and contains the phosphorus in numerous little globules which may be melted into one by gently heating in a water bath.

If it be necessary to make a quantitative estimation of the phosphorus, it may be changed into phosphoric acid by means of an excess of pure chlorine, and then estimated by the well known methods. When the amount of phosphorus in the unoxidised condition is too small to to be obtained in globules, the distillate still shows luminous vapours in the dark. It also gives with nitrate of silver the characteristic blackish precipitate of phosphide of silver, or reduced silver, which equally establishes the existence of phosphorus.

The author also gives the following simple process for detecting the presence of phosphorus. Supposing the contents of a stomach, food, coffee, &c. have to be examined, they are placed in a flask mixed with enough distilled water to make a thin magma. Some pure sulphuric acid is now added, and a strip of paper slightly moistened with a weak alkaline solution of nitro-prusside of sodium is inserted, and held by a loosely fitting cork. If the least trace of sulphuretted hydrogen is developed the paper will be turned blue. Lead paper would in the same way be turned black. When convinced of the absence of sulphuretted hydrogen, hang in a piece of Swedish filtering paper having on it some lines and dots made with a solution of nitrate of silver, which will show the presence of phosphorus by becoming blackened from the formation of phosphide of silver. If the blackening takes place quickly, and is very intense when the flask is gently warmed on a water or sand bath, more paper may be suspended well impregnated with the silver solution. In this way a good quantity of phosphide of silver will be obtained. The paper may then be treated with chlorine water or aqua regia, the solution filtered from the chloride of silver, and the filtrate evaporated on a water bath. The formation of the ammonio-phosphate of magnesia or the yellow phospho-molybdate of ammonia with the residue is a certain proof of the existence of phosphorus in the matters examined.

When the object is to estimate quantitatively the still unoxidised phosphorus, the distillation apparatus of Mitscherlich is connected with a couple of two-necked bottles. The first of these must contain about an inch deep of distilled water, into which the tube of the apparatus must dip. The second must contain some neutral or slightly ammoniacal solution of nitrate of silver to fix all the phosphorus vapour which may not be condensed by the cold distilled water. After the distillation is finished the apparatus is disconnected, and the tube rinsed out with a little distilled water. The small globules of phosphorus in the first bottle may then be united by heating gently; and the water which may contain phosphorus vapour and a trace of phosphorous acid should be added to the contents of the second bottle. By gently heating the mixture phosphide of silver is formed. Some aqua regia is now added, and the whole is evaporated. On filtering from the chloride of silver, a clear solution of phosphoric acid is obtained, the amount of which may be estimated in the ordinary way, and the phosphorus calculated therefrom.

When the phosphorus has been changed into phosphorous acid the determination can be made in the same way. The suspected matters must be treated in the apparatus of Mitscherlich with some sulphuric acid and pure zinc as long as the hydrogen developed carries along with it any phosphuretted hydrogen, and the gases must be passed into a solution of nitrate of silver to fix the phosphorus. The estimation can then be made as before.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, 23 March 1860.

On Diamonds, by Nevil Story Maskelyne, *Esq., M.A., Keeper of the Mineral Department, British Museum.*

Lord Wensleydale *in the Chair.*

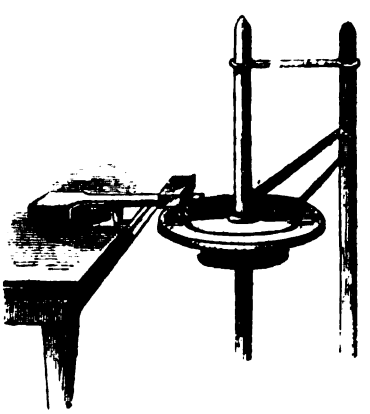
The progress of chemistry within the last few years has been rapid and very great, but rapid and great as that progress has been, it is principally to one branch of chemistry that it has been confined. For it has dealt more with synthetical processes,—processes which have to do with compounds and the classification of compounds, than with what might seem *primâ facie* to be the most interesting subject for chemical inquiry, namely, the nature and properties of the elementary bodies of which those compounds are made up. Thus this science is going on constantly and untiringly adding to its lists of compounds, and the now enormous volume of organic chemistry is no other than the chemistry of carbon. Yet if you ask the chemist what he knows about this carbon itself, it is surprising how little he has to give for answer. He knows, for instance, that in a variety of localities in nature is found a substance with by no means constant characters, called by the mineralogist graphite. He also knows that the body called coke is a product of the gas works. He knows that these and that charcoal and lampblack are carbon, and that the diamond is no less carbon. He further recognises in this wonderful body, called by the jeweller *carbonate*, a form of carbon possessing indeed more than the toughness with equal hardness, though with rare traces only of the crystal form and crystalline cleavable structure of the diamond; so that it is more like diamond than either of the other forms of carbon which I have mentioned. Beyond, then, the recognition of these apparently different shapes of carbon, the chemist can give little positive knowledge regarding the true nature of this protean and plastic element, for if you press the inquiry further, and ask him what he knows of the number of allotropic states in which carbon may exist, or the methods of forming these, he has to confess that he has but little sure knowledge on the subject. The crystalline form even of graphite is still not determined with certainty, and the formation of the diamond is an unsolved problem. Of all the forms in which elemental matter presents itself to us, there is not one probably in all the range of chemistry so interesting as that which I have selected for the subject of this evening. And what invests the diamond with this great interest? It is that the diamond is a substance which transcends all others in certain properties to which it is indebted for its usefulness in the arts and its beauty as an ornament. Thus, on the one hand, it is the hardest substance found in nature or fashioned by art. Its reflecting power and refractive energy, on the other

hand, exceed those of all other colourless bodies, while it yields to none in the perfection of its pellucidity. Indeed when one thinks of this hardest, most pellucid, and profoundly refringent substance as an elemental form of matter occurring in nature and thus highly endowed, one is tempted for a moment to see in it something of a realisation of that old idea of the philosophers of the days of Paracelsus, which believed it to be possible to extract from a given series of things a certain material essence endowed with the qualities of these things in an exalted degree and as it were in an abstract form, and which they denominated the *quinta essentia*.

First among the properties of this interesting mineral, the diamond, I will speak of that for which it is in its application the most useful and prominent—its hardness. There is no other substance yet known in nature rivalling it in this respect. Indeed, were the diamond not so beautiful a gem, its price in the crude state would hardly be less than it is now, for the uses to which it may be applied are innumerable, and its application to them is only limited by its rarity and cost.

First, I will invite your attention to its most ordinary application, namely, to the cutting of glass. It was shown by Wollaston that a fragment of diamond cleaved from a crystal in its ordinary condition, namely, with plane surfaces, will not effect an incision in the glass, but only abrades the surface of it, so that to cut the glass you must take those rounded crystals of diamond whose cusped edges are formed by the meeting of rounded facets, constituted apparently by an oscillation in the direction of the crystal forces, which may at one time have tended to deposit the molecules in planes parallel to an octahedron, at the next moment in those of a trihedral or hexahedral pyramid on each octahedral face. It is only these rounded forms that the glazier can employ. The *writing* diamond, on the other hand, is a mere fragment or splinter with plane sides. The rounded edge of the glazier's diamond forms a fine clean cut, while the other produces only a scratch. I will show you that presently by the aid of the electric light, by converting it to the purposes of a magic lantern. Another illustration of the uses to which the characteristic hardness of the diamond has been applied, is the cutting of the diamond itself. The diamond and other hard minerals are cut with the powder of diamond, and powder of diamond will alone cut the diamond. The process is performed by this apparatus, called a skyf (pronounced skiv),

Fig. 1.



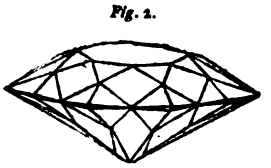
which consists of a plate of a peculiar kind of iron, neither too hard nor too soft, and which is made to revolve with an immense velocity. Upon this a very minute quantity of diamond dust, with oil taken from this small iron mortar by a quill, is carefully applied, and this soon becomes imbedded firmly in the iron, like the sand on sandpaper. This instrument is a brass hemisphere mounted in a stem, and it carries a mass of fusible metal into which, while yet very hot and soft, the diamond is inserted. The hole is here where the diamond was placed when the last stone was cut; then this arm, carrying the diamond in its metal setting, is placed upon the table with its end projecting over the skyf, and with the hemisphere inverted, so as to bring the diamond into contact with the surface of the revolving plate. A weight is put upon this arm, over the end where the diamond is, and by a motion of the wheel in this direction the grains of diamond are brought to do their work. It is a beautiful thing to see the diamond cutter perform his operations, which he does with exquisite skill and almost mathematical accuracy. The first preparation of the diamond, indeed, is effected by actually bruising off the salient solid angles of the stones by a skilful grating of one against the other in this little box, a diamond being fixed to each of these little handles by cement, and the dust formed being caught in the box beneath, in which it is sifted. This diamond dust is, to the eye, of a peculiar grey colour, and Petzholdt says it never has the colourlessness of the diamond, but presents a grey hue from the pounded diamond being partly resolved into black particles. When, however, this dust is examined under the microscope (and I have examined it myself) it is perfectly pellucid and entirely colourless, for the grey hue is seen to be produced to the eye in consequence of the light being broken up by the highly refringent substance and strongly reflecting surface of the powdered mineral.

Well, now I pass on from these physical and practical illustrations of the hardness of the substance of the diamond to another subject—that of its optical characteristics. First of all, let me allude to its adamantine lustre, arising from the completeness with which it reflects or throws off from its surfaces so large a portion of light, I do not say every ray that falls on it, because part of that light enters the diamond and undergoes refraction in it. There is a little lost by the sort of scattering produced by the mechanical imperfections of the polish, but in the diamond this is extremely little, and almost the whole comes off to the eye or is transmitted into the body of the diamond. When you pursue this question further and ask what becomes of that ray of light which enters the diamond, you find that the retardation of its velocity and consequent divergence from its course is in the diamond exceptionally great. In fact, though there are two or three transparent substances known which are more highly refringent than the diamond, they are minerals of deep red or yellow tint, while of colourless minerals generally, and especially those stones coloured or otherwise whose lustre and beauty have made them gems, none approaches the diamond in refringent energy. To give you an idea of the intensity of this refractive power, I might say that the refractive index of glass is to that of diamond somewhat as the ratio of the figures 16 to 25, so much more is the diamond refractive than glass. To explain this more exactly, suppose a ray of light passing through the air or any other substance impinges upon the surface of some denser medium, say water, or glass, or diamond, then if its course be at all inclined to the surface of that medium it is diverted from the direction of that course, and is plunged more or less profoundly downwards into the denser substance. You will, I think, understand this at once by looking at this card model. You will find that the sine—as this horizontal moveable bar, always perpendicular to the vertical line, is called—I say this *sine* of the incident ray is always greater than the sine of the refracted ray. How much greater? Its magnitude is measured by this law: that in every substance there is a given figure by which you must multiply *this* sine, the "sine of refraction," to produce the incident sine. Whatever the position of this ray, then the sine *here* will bear to the sine *there* exactly the same proportion. Now supposing this, the incident, ray becomes horizontal, *i. e.* to say parallel to the surface of the refracting medium, then the progress of that ray is arrested at a certain angular distance from the vertical line, and this angle is called the critical angle. Now let us

suppose the ray to be travelling in the opposite direction, *i. e.* from the denser to the rarer medium, so long as its direction is along a line comprised within that angle, there is a possible direction in which it can emerge. That emergence will take place then at an angle corresponding in its sine to the requisite multiple of the sine of the angle its course makes in the denser medium; but when it exceeds that critical angle in its original direction where is it to go to? how is it to emerge? there is no possible sine now for any angle at which it *can* emerge. What will become of such a ray? Experiment answers this question. The ray incident on the rarer medium beyond the critical angle is totally reflected into the denser medium again. Here is an experiment or two that will exhibit this. [But first I will fulfil my promise to exhibit to you the results of the use of the cutting and the writing diamond. You see there I throw upon the screen three or four marks on the glass. That one to my left is the clear cut of the cusp-shaped edge of the glazier's diamond; then that diagonal mark is a *crack* in the glass; and then there are two *scratches* from the writing diamond. One can thus very clearly see the different results in the two cases.]

Now to illustrate what has been said of total reflection. I have here a little prism which is constructed at such an angle that if a ray enters it on this face, thus, it comes in contact with the second surface of the prism at so high an angle that it is impossible to pass out through that surface though transparent, and the result is that I have total refraction; but, first of all, I must explain to you that when I throw the image thus totally reflected on to the screen, it will exhibit the result of any other image seen by reflection, namely, it will be inverted so that the points of glowing charcoal, which are now seen directly on the screen, will be seen topsy-turvy when thrown there by a total reflection. Now I shall be able to direct that totally reflected image to the screen, and I hope thus to show you that the rays are in this way completely reflected from the second surface of this prism. Now I will bring into that beam my prism, and you see immediately I get an inversion of it. You see I pass it up and down, and there it is traversing the screen inverted; that then is a proof of the total reflection of the light at the second surface. Let us try another way of illustrating this. Observe, I make the same image now travel along the ceiling, down this side of the room, and so right under where I am standing, and up on the other side. Now if that prism would allow any light to go through it (and remember it is a simple piece of polished glass), you would see it on that screen, but there is darkness, so that all the light must have been reflected. I have dwelt on this so long that I might be able to illustrate to you the subject of the Brilliant. The jewellers prefer the diamond when it is cut in what is called the brilliant form, that is to say, in the form depicted here (*fig* 2), which is a rough sketch only of a not very perfect form of the brilliant, that into which the Koh-i-Noor now is shaped.

Fig. 2.



The prism, which is formed by one of these lozenges on the so-called bezil, and by those two opposite "pavilion" facettes, must be so formed as not to allow any light to pass through it. For this purpose it must be so constructed that the angle here at the girdle must be twice the limiting angle which I have explained to you. Now, in consequence of the high refractive power of the diamond, and the resulting smallness of the critical angle, we are able to construct a prism of diamond with an angle of 46° that will as effectively cause all light to be totally reflected at its second surface, as one of glass would do with the far larger angle of 80°, or one of sapphire with an angle of 68°, and the consequence is that you are able with the diamond to get a brilliant of flatter form than with any other substance. Thus by giving a proper inclination to the planes that form the bezil on those that form the pavilion of the brilliant, and by properly proportioning the extent of the *table* facet and the little facet, called the *collet* or *culet*, which truncates the portion of the stone below the girdle, we obtain the remarkable result that no light can escape through the diamond downwards, except the few rays that traverse it perpendicularly on the culet. All the other rays will be reflected totally from the pavilion facettes and from the culet, and will have to emerge again, at various inclinations, from the summit planes; and as they will emerge at such inclinations, they will necessarily be broken into the prismatic colours. The precise adjustment of the angles, and the dimensions of the planes of the brilliant, is a mathematical question which has hitherto perhaps never been fully investigated.

I am indebted to Mr. Martin for the magnificent display of brilliants and other diamonds, including this most beautiful series of naturally coloured diamonds, which I am able to show you to night. Indeed, if some small principality is looking out for a sovereign, I would recommend Mr. Martin to them, as being able to take his regalia with him. I will now pass an intense beam of electric light into this splendid brilliant of nearly 20 carats. See, its image on the screen forms a black opaque square, so that the diamond actually acts as a screen, and not a trace of light comes through it except that small quantity which passes in perpendicularly through the table, and out at the culet. No experiment can be more satisfactory than that to prove how completely the diamond cutter has attained his object, and that remember by an art — like so many other arts — ripened long before science had explained its instinctive principles, for at the time of the first cutting of brilliants the law of refraction even could hardly have been known.

Now, when I am about it, let me exhibit this diamond to you, under conditions at once novel and dazzlingly beautiful. See it now glowing in the intense light of this electric luminous beam. Look at it — please to observe not only the reflected splendours, but the wonderful intrinsic luminosity of that diamond. It glows like the sun. Look about the room and on the ceiling, at the dazzling lights reflected from it. But there is an intensity about its own brilliancy which is not alone due to the light which is being thus powerfully poured into it and is as fiercely fighting to get out again, but is due also to a power the diamond has of absorbing and appropriating, so to say, and giving out that light again, a power of fluorescence. I may add that in making some experiments yesterday, with Dr. Faraday and Dr. Tyndal, we came across another phenomenon with another diamond belonging to Mr. Martin. After we had kept that diamond for some time in this electric ray, and then extinguished the ray, the diamond retained a phosphorescent light of its own for at least three quarters of a minute afterwards. I will now illustrate by experiment, the dispersion into the prismatic colours, of the light which falls at inclined incidence on the faces of the brilliant as it emerges from it. The diamond though so very powerfully refringent in its action on light, is not relatively nearly so dispersive; that is to say does not refract the differently coloured rays with so varied an energy as many other substances do. The spectrum thrown by the diamond is, however, wonderfully intense and distinct and beautiful, more so really than that from glass. It would be hardly fair indeed to compare this large and brilliant spectrum thrown from this fine flint glass prism with any that I could form by means of this small brilliant; because, as compared with the glass prism, the diamond is but a mere fragment (although valued at hundreds of pounds). It is a thin "spread" brilliant, which I found in the collection of Mr. Martin, having its facettes so cut as to comprise the angle I require. Here then is the spectrum from the diamond thrown upon the screen. As I said before, you will reason not by direct comparison of the size or

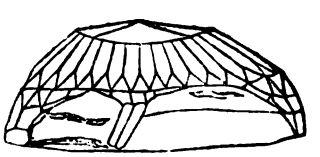
intensity of the two spectra formed by it and by the glass, but by comparing the results with the prisms that produce them. This little fragment of diamond is throwing a spectrum quite comparable, in the clear separation and purity of the colours, to that proceeding from the glass prism.

Let me now advert to another subject, namely, the geographical and geological association, and the chemical history of the diamond. I shall say but little about it. India, Malacca, Borneo, Brazil, Mexico, the United States, the Ural Mountains, and, as has been asserted, Australia, and also (though it needs much to be confirmed) Algiers, these are all localities in which the diamond is found, and in them all it occurs in alluvial soils, which are the result of the attrition and wearing down of older rocks. The theories dealing with the formation of the diamond are many. We have the authority of Liebig in support of the view that diamond has been produced by a process of eremacausis, such as has gradually resulted in the formation of anthracite. Another view supposes it to be possible to separate carbon in the diamond state from chloride, sulphide, or iodide, or from some other binary compound of it, by the intervention of some third element which shall have power gradually to replace the carbon. Then another has been suggested that, although we have never seen carbon at a temperature sufficiently intense to convert it into vapour, and though we have no proof that it was ever in a state of vapour, yet it would seem reasonable to suppose that, under proper conditions, carbon ought to vaporise, and might then condense as diamond—that is a third theory. And a fourth might be that, supposing the diamond to be incapable of undergoing fusion at ordinary pressures (though there seems no reason to suppose it is not), yet, on the further supposition that—as in the case of arsenic, the fusion of which does not take place under the atmospheric pressure, from the immediate conversion of the solid into the gaseous element—so (as may be effected with arsenic) by the combined influences of intense heat and great pressure, molten carbon *might* be formed, and the cooling of this might produce diamond. M. Desprez, indeed, has laboured hard to produce the diamond from the passage of a Voltaic current, for long periods of time, one of the poles being of carbon; but these labours have, I fear, not been rewarded with the success which the patience they represent would seem to deserve. But there is, besides all these speculations, another direction in which the production of the diamond may be looked for. It is well known that iron, when surcharged with carbon, though it may dissolve it when in a state of fusion, deposits the excess of carbon as it cools, but deposits it in the graphitic modification. Some other metal, or some change in the conditions with the same metal, might cause the extrusion of the carbon in the form of diamond. Another theory again may be founded on the analogy of the silicates from which magnesium, when burnt in contact with them, separates the silicon, as does lithium at a temperature far below red heat. Some alkaline or earthy metal, it might be reasoned, may, under special conditions, set free the carbon from carbonates, by an analogous reaction. Chemistry is certainly not in a position to deny such a possibility.

But on reviewing all the facts that are known regarding the parentage of the diamond or its rock home, wherever that may be, it must be confessed that we are in the dark. Its origin in the earth, indeed, and the manner of making it in the laboratory are two distinct questions; but in our real ignorance of both, we may discuss them as if they were one. The companion minerals associated with the diamond in alluvial soils are, like it, wanderers from more or less distant mountains, which mountains have been produced by earthquake forces, or have been acted on or changed by terrestial heat. They are, in fact, composed of metamorphic rocks, whose age is unknown, and whose characters are probably due to the transmuting agency of chemical forces, powerless for effecting change in any ordinary period of time, but acting slowly and surely, and producing complete transformations of mountain strata, such as that from clays to slates and schists, when their operation has been aided by comparatively low degrees of heat, and been extended through periods that make the thought giddy. What then are the companion minerals thus occurring with the diamond? Universally gold is its more or less near neighbour. Platinum is rarer but hardly less ubiquitous. Then in addition to oxides of iron and of titanium, we have tourmaline, topaz, chrysolite, chrysoberyl, kyanite, and other gems; in fact a large assortment of minerals, in which silicates were the chief ingredients. And that is not all, for itacolumite, a rock of which this flexible sandstone is a kind, occurs in several of the diamond countries. It is a rock composed of quartz grains, in layers, cemented by mica, often too by talc, and associated with other minerals. This specimen is from India, that from Brazil, close to the diamond country, and in this rock in Brazil the diamond has actually been found. Nor is that all: last year it has been shown that the diamond occurs in hornblende slate in the Brazilian province of Minas Geraes. Let me also add one fact, which may prove a significant one. In two or three important diamond districts dolomite also occurs. But to the chemist all these facts speak in a vague language, for they do not tell him whether the diamond has been formed in the primeval clay or other deposit from which these metamorphic rocks may have originated, or has been produced during or even since the metamorphic transformation of them was effected. Nor do the substances imprisoned in the diamond throw much light on this inquiry. Splinters of ferruginous quartz are certainly so enclosed, and gold has been said to be so in a diamond now at Vienna. But besides these nothing but carbon has been proved to exist in the flaws of the diamond. But the chemist has at least one great result of his own laboratory to point to, a result all the more interesting as being the immediate offspring of a renewed attention to the chemistry of the elements. The chemist has lately made diamonds; not indeed *carbon* diamonds, but *boron* diamonds, and *silicon* diamonds. Boron and silicon are so closely allied to carbon that it is a very significant fact that they are proved to exist in allotropic states precisely analogous to the adamantine, the graphitic and the amorphous modifications of carbon. For our knowledge of this we are indebted to the recent discovery that aluminium can be produced in the form of a workable and useful metal. Just as iron by a surcharge of carbon can, on solidifying, be induced to reproduce that carbon as graphite, so can boron and silicon be separated from aluminium in graphitic modifications, and from zinc in forms of octahedra of different crystalline systems indeed, but with physical properties closely resembling diamond. I will exhibit the images of these crystals presently by the aid of the electric light. This result is one which should certainly encourage the chemist to renewed efforts to produce the diamond, and to study those refinements of chemical and physical conditions on which doubtless the production of different allotropic states of matter depend.

You will now allow me at once to plunge to 320 years ago, into the centre of India and Indian history, and to transfer your attention to another but interesting subject—the history of the Koh-i-noor diamond. I believe there is

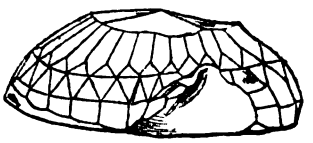
Fig. 3.



nothing about which so much mistake has been made as the true history of that diamond. Large diamonds are extremely rare. Here is a model of the Nizám diamond, which was one of the greatest perhaps ever known. This is that of the Orleans or Pitt diamond, the beautiful crown jewel of

France, the finest cut brilliant in the world. But I am now going to speak of the Koh-i-noor. This is the model of what it was in 1851, alas! not what it is now, for it has been cut. (*Fig.s* 3 and 4.) Some may look on this diamond as a bauble..

Fig. 4.



The Indian, looking back to the centuries of the past history of his fathers, calls it a talisman, the talisman of oriental empire. We here may not agree with either, but I hope to prove to you that we must see in it a wonderful historical monument. Its history, indeed, is almost the history of India, and its own records are told in part by authentic history, in part by tradition, and partly also in yet older days by that sort of tradition which is legend, and in which we lose sight of historical characters in the shadowy forms of heroes and demigods. Thus the fancy of the Hindoo identifies the old diamond of India with one of which the legend tells that it was discovered by a Zemindar, near Masulipatam, in the bed of the Godaveri, during the time of Krishna, 5000 years ago, and was worn by Karna, king of Anga, who fell in the great strife recorded in the Mahabharáta. It is then traced onward by the same wild sort of record to a great rajah of Usjein, in Malwa, who lived perhaps 57 B.C., but but whose very name, Vikramádytia, is a mythic one.

Tradition, however, of a more solid kind, asserts that the diamond was won by Alá-ud-dín from the rajah of Malwa, in the year 1304, which accords with Baber's statement that Alá-ud-dín was the first Pathán sovereign of Delhi who possessed it. Baber in his memoirs, which are about the most interesting documents ever written by a prince, and which are unquestionably authentic, states that after one of those great battles of Paniput, which in different centuries have decided the fate of India — after his battle of Paniput, he sent on his son Humayún to Agra, where he became possessed of "*one famous diamond, acquired originally by Sultan Ala-ud-din, and which was estimated to weigh* 8 *mishkals.*" I am now going to enter at once to hard figures and on what those 8 mishkals mean. Singularly enough the sultan Baber himself states in another part of his work, which has been hitherto overlooked in this discussion, that the mishkal, a Persian weight, actually weighed 40 ratis. The rati is this little red seed, the *abrus precatorius*, as this little bean from the carob bean, is the kharouba of Arabia, the Greek κεράτιον, and our *carat*. Well 40 of these ratis were equal to 1 mishkal. If you multiply 8 by 40 the result is 320 ratis. Thus "the famous diamond" weighed 8 mishkals, which is = 320 ratis = 40 mashas = 10 tanks = $3\frac{1}{3}$ tolas, as is shown in this table: —

8 Ratis	=	1 Mashah				
32 Ratis	=	4 Mashahs	=	1 Tank		
40 Ratis	=	5 Mashahs	=	$1\frac{1}{4}$ Tank	= 1	Mishkal
96 Ratis	=	12 Mashahs	=	3 Tanks	= $2\frac{2}{3}$ Mishkals	= 1 Tola.

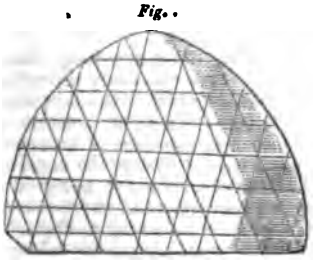
Now in 1851 the Koh-i-noor weighed 186·0625 carats = 589·82 troy grains, not carat grains, but troy grains (Professor Wilson, our eminent Sanscrit professor at Oxford, who has given the only good narrative of the old history of the Koh-i-noor, confounded these varieties of the grain in that narrative). If this famous diamond of Sultan Baber's autobiography weighed 8 mishkals, the question is what was a mishkal in Baber's time. In order to answer that question, I have gone through much of the numismatic and other lore bearing upon it which I could get access to for the period, including the Sassanian and the Græco-Roman empires to the present day, and I have availed myself of the materials and of the help of my colleagues in the coin room at the British Museum. One of the most remarkable records bearing on this subject is the ancient treatise at Makrizi. He states the exact relation of the mishkal to the denarius and dirhem, and the relation of the Syrian mishkal to the Greek mishkal in the times of the Caliphat, which Abúl-Fuzl states to be the same as that of the Indian to the Greek, and the result would be that the mishkal would weigh 74·2 grains. Taking the Koh-i-noor at 8 of these, it would weigh $187\frac{1}{2}$ carats. Now a modern Persian goldsmith's mishkal weighs exactly $74\frac{1}{2}$ grains, and the result of that would be 188 carats for the Koh-i-noor. The mercantile mishkal weighs 73·975 grains, giving for the Koh-i-noor 187 carats. The mishkal of Bussorah (the El Basrah of the "Arabian Nights," the ancient outport of Arabia on the Persian Gulf) gives 182 carats, and the modern Bokhara mishkal, which is the place from which Baber came, would give 179 carats, which is the lowest that I get, while the highest is $187\frac{1}{2}$ carats. Then I go on from the calculation of the Persian weight to that of the Indian weight, the tola, and I come to a very curious result, not quite so high, but still very remarkable. The Indian tola is a very ancient weight; it had been the standard of some of the ancient Indian coins long before Baber's time, and until Shír Shah's time was probably pretty uniform as a weight. Shír Shah changed the money standards from the mishkal (the Mahommedan weight) and from the old tola and adhali, to a new Hindoo standard, in which the tola became 186 grains. I will simply state that the result of calculations made from some splendid gold coins of Mohammed Tughlak enables us to take the old tola to the reign of Baber at a minimum of 173, and up to 174 or perhaps 175 grains. This gives our diamond a weight of from $182\frac{1}{2}$ to 185 carats. Now I venture to think that after these facts I am fairly justified in saying that the weight of the Koh-i-noor in the Great Exhibition, represented more accurately than any other diamond which is known the weight of the famous diamond which the Sultan Baber had, and to which the old legends and traditions as well as the authentic histories of India refer.

Now in 1675 a French traveller of considerable reputation, Jean Baptiste Tavernier, who was a diamond merchant, was in Delhi at the time Aurungzebe was king, and while his father, Shah Jehann, was his state prisoner. Shah Jehann had all his jewels in his prison with him, and thus while he had whatever enjoyment was to be derived from their possession, his son enjoyed the pleasures to be derived from the occupation of the throne. That he retained among these the most valuable of those that formed his personal property is proved by this anecdote. Shortly before the death of Shah Jehann, Aurungzebe sent to demand from his father those jewels which he retained, upon which Shah Jehann answered, that sooner than give them up he would smash every one of them in the mortars which he held ready for the purpose. Then the question was, how came Tavernier to have seen a vast diamond, which he describes, and which, from the account he gives of it, would have been, not a crown jewel of the empire, but a personal acquisition of Shah Jehann's; and if he saw only that one great diamond, where was the old "famous diamond"? It seems to me the true answer is that Shah Jehann had in his captivity with him the diamond whose history Tavernier gives, and that the one Tavernier saw was the old crown jewel, then for 360 years the property of the sovereigns of Delhi. Indeed history records that after Shah Jehann's death his private jewels were surrendered to Aurungzebe by his sister Jehanira. His death was in February 1666, and Tavernier saw the royal treasury in November 1665. On that occasion Aurungzebe sat on his throne, and the French diamond merchant was authorised to inspect his jewels. Among them he saw the large diamond in question. He describes the solemnity, the state, and precaution with which it was put into his hands, and $319\frac{1}{2}$ ratis he states to have been the weight of it; 320 ratis, you will remember, was the weight of the diamond which the Sultan Baber had. Tavernier describes it as a "*rose ronde*," that is, a rose cut stone, with the corners rounded, "*very high on one side*," and that is what we have

never seen in any other diamond than the Koh-i-noor. If we take the Koh-i-noor standing so, it is much elevated on this side. Then the description exactly accords with the description of Tavernier. And if it were set in that position, and so that the girdle shall come round in this direction, which is somewhat as it was set in Runjeet Singh's day, it is in such a position that two incisions which are in it are hidden, and a third comes into view. Now Tavernier's description of the diamond is this—he states that on the lower edge there is a little notch, and a small flaw inside of it. This would then be a precise description of the Koh-i-noor. The water, he says, is fine, and it weighs 319½ ratis. He then goes on with a long description of this stone, which, according to this account, had been found by a Persian adventurer, who got himself in a mess at the Court of Golconda, and who gave it to Shah Jehann to purchase his goodwill. Now there was the old diamond of Sultan Baber, which weighed 320 ratis, and Aurungzebe we see had one of 319½ ratis. Then where is the other? I think I have answered that question. We know that Aurungzebe must have had the original crown jewels, for the peacock throne which he sat upon was built up of them, and therefore the jewels which Shah Jehann had with him in the city of his captivity could hardly have been any of the jewels of the crown, but would have been, as I have said, his private cabinet; and he was said to be the best connoisseur of jewels in his empire. Tavernier therefore must have seen the old diamond of Baber, and not the Golconda diamond which bought the help of Shah Jehann for the Persian adventurer Ameer Jumla. But Tavernier, who could draw a diamond well, has given us a very bad sketch of the diamond he saw.

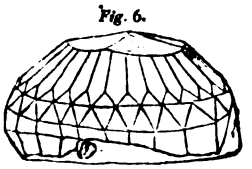
Now *these* are drawings of the Koh-i-noor, and that (*fig.* 5)

Fig.



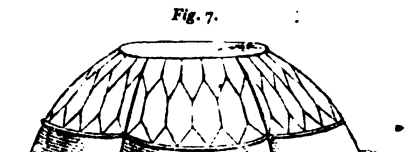
is Tavernier's drawing, which you will see is a very rough one indeed. *That* (*fig.* 6) is a view of the Koh-i-noor, taken

Fig. 6.



as accurately as it could be drawn, end on. *That* (*fig.* 7) is a drawing which Miss Eden drew of the Koh-i-noor when

Fig. 7.



it was in the possession of Runjeet Sing. They are sufficiently similar to be possible representations of the same diamond—they are sufficiently unlike to be considered no two of them as accurate representations of the same stone. Yet Miss Eden's is actually the Koh-i-noor, with the setting in which Runjeet Singh wore it.

That is the whole of the history of the Koh-i-noor that I wish to give you to-night. To continue it would be to follow it down through the long details of a wild and romantic history. But from that day to this the history is clear. It received its name from Nadir Shah, who, when India lay at his feet, met his half vassal, the Emperor of Delhi, who wore in his cap the great diamond of his fathers. Nadir saluted him, and exchanged turbans in sign of eternal amity. The Mound of Light then received its Persian name, and passed the Indus with its new master. It saw the rise, and helped the downfall of the Douranee empire, and passed by treachery, or even worse, into the clutch of Runjeet Singh With his descendants, the shadow of England passes over the Punjaub, and the one famous diamond of India falls into the hands of the conquerors from the distant west.

If there are any of you who would wish to remain, I will show you a few illustrations of those forms of boron and silicon to which I have alluded.

First of all, if you please, I will take boron. These hexagonal plates are the analogues of the graphitic form of carbon. There you can see the little hexagonal plates beautifully. In these images, again, you may see the lozenge shape of the outlines of the octahedra, first of the boron, and here of the silicon diamond. I may add to that a very curious fact. Dr. Faraday put into my hand, just before I entered the theatre, a round mass of boron that M. Dumas sent to him from Paris, precisely like that form of diamond which is called boart, and which consists of a confused congeries of crystals.

Now I propose to show you a few beautiful phenomena.

The learned lecturer then exhibited in the beam of the electric light a beautiful Maltese cross of diamonds, a beautiful large diamond briolet (a single stone) producing a most dazzling effect, and a chrysoberyl, which is surpassed in brilliancy and limpidity by no stone but the diamond itself. The effect of it, though brilliant in the extreme, lacked the glow which the diamond presented. Next the light blazed on a collection of the most beautiful coloured diamonds, beautiful not for their size but for their purity of colour and fine water, which Mr. Martin had been a long time collecting. Mr. Maskelyne then reflected the iridescent surface of a most beautiful opal upon the screen, and afterwards of a mass of opal. To convey anything like an adequate idea of any of these splendid phenomena is beyond the ability of pen or pencil.

CHEMICAL SOCIETY, *Anniversary Meeting*, 30 *March*.

Professor Brodie, *F.R.S. in the Chair.*

The report of the Council was read and adopted, and the following officers were elected for the ensuing year. President: Brodie, B. C., F.R.S. Vice-Presidents, who have filled the office of President: Brande, W. T., F.R.S.; Daubeny, C. G. B., M.D., F.R.S.; Graham, Thomas, F.R.S.; Miller, W. A., M.D., F.R.S.; Playfair, Lyon, Ph.D., F.R.S.; Yorke, Colonel Philip, F.R.S. Vice-Presidents: Frankland, E., Ph.D., F.R.S.; Jones, H. Bence, M.D., F.R.S.; Porrett, Robert, F.R.S.; Smee, Alfred, F.R.S. Secretaries: Redwood, Theophilus, Ph.D.; Odling, William, M.B., F.R.S. Foreign Secretary: Hofmann, A. W., LL.D., F.R.S. Treasurer: De la Rue, Warren, Ph.D., F.R.S. Council: Field, Frederick; Francis William, Ph.D., F.L.S.; Longstaff, G. D., M.D.; Marcet, Dr., F.R.S.; Mercer, John, F.R.S.; Noad, Henry M., Ph.D., F.R.S.; Normandy, A.R.L.M.; Roscoe, H. E., Ph.D.; Schunck, Edward, Ph.D.; Voelcker, J. A., Ph.D.; Warington, Robert; Williamson, A.W., Ph.D., F.R.S.

NOTICES OF PATENTS.

Hydro-Carburation of Peat.—Provisional protection only.—J. H. Johnson. *Communicated by M. de la Fenestre.*

As this invention only received provisional protection, we should scarcely have noticed it were it not that it shows that there is no process too absurd to be patented.

"The essential feature of this invention is the carburation, or hydro-carburation of peat, and other similar fuel, by a wet process, the object being to obtain as much hydrogen as possible in the fuel and expel the oxygen, which may be effected in various ways. According to one method, the peat is passed through bruising rollers, or other reducing apparatus, over a vessel containing ammoniacal water, which soaks the peat at the same time that it undergoes the bruising process, the object of the operation being to thoroughly impregnate the peat with the alkali. Another process consists in substituting two successive baths for the one above referred to, the one containing a ferrocyanide of ammonia and potassium, and the second a metallic chloride or acetate of iron. By this process also the peat may be charged with alumina, or any neutral body, by using a bath of dilute ammonia and a bath of acetate of alumina. The process may also be accomplished by the aid of fermenting agents, such as yeast, albumen, caseine, &c. The result of the action of the alkalies upon the peat is that the peat assumes the properties of an acid relatively to the bases, and offers facility for the introduction therein, either by simple or double decomposition, or (*sic*) of hydro-carburetted salts, or of greater or less quantities of carburets or hydro-carburets, and thereby augment considerably the combustible value of the fuel and its gas-producing powers, carburetted peat being found to produce as much gas and coke as pit coal." At last a full point! We never were more thankful for an opportunity to come to a full stop. Imagine ammonia, ferrocyanides, yeast, albumen, caseine, &c. as sources of hydrogen for gas. Acetate of alumina to yield a fixed residue as a source of coke. Peat assuming the properties of an acid—we are not forgetting the real peat acids. Does our inventor not know that nitrogen is not a great improver of illuminating gas? Does he not know that albumen is now at an almost fabulous price, owing to the quantities now used for mordanting the new colours? It is painful to see such processes seriously given to the world.

Manufacture of Metallic Compounds or Alloys. Robert Mushet.

This is a patent for procuring an alloy of tungsten and iron, or of tungsten, iron and manganese. Divesting the process of the verbiage common to patents, it simply consists in mixing various quantities of wolfram with hæmatite, specular, magnetic, or spathose iron ores, or, especially, granular hæmatites or iron sand. The patentee does not state the nature of the advantages he expects to derive from the process, but, nevertheless, he finds the best results to be obtained when the resulting alloy contains from half a per cent. to ten per cent. of tungsten. A tolerably wide range! The patentee also finds, as might have been expected, that the greater the per centage of tungsten, the greater the specific gravity of the alloy, which is not very wonderful when we remember that the specific gravity of tungsten is 17·6, while that of iron is only 7·8.

Utilisation of Madder Residues, by Prosper Faure *and* Jules Pernod, *Avignon.*

This is an attempt to convert to use as a manure the nitrogenous matters which combine with the sulphuric acid in the preparation of garancine. In washing away the acid from the garancine so large a proportion of water is necessary that hitherto, the fuel required to evaporate it off, has been more valuable than the resulting product. The patentees endeavour to get over this difficulty by an economical mode of applying the heat. They do not attempt to collect all the washings from the garancine, but only the first two or three, the rest being too weak to be used up economically. They employ a brick oven, similar to those used in the concentration of the solution of carbonate of soda in the process for manufacturing that article. But as the flame dashes over the fluid, the soot, &c. resulting from the combustion of the fuel becomes to a great extent deposited, and at the conclusion of the operation will be found in the residue. The latter consists of ulmine, saline matters of various kinds, and a certain proportion of ammoniacal salts. Of course a great excess of sulphuric acid is present, which the patentees propose to saturate with chalk or quicklime.

It is plain that the above process contains the elements of failure unless superintended with great care.

In the first place, it is questionable whether in these days of expensive fuel the residues will pay for the expense of obtaining them. It is true that the patentees use the surplus heat to dry the garancine, and this, to some extent, gives a favourable aspect to the affair. The excess of sulphuric acid is so great that it becomes necessary to saturate it, but the operation, unless conducted carefully, would cause the loss of the ammonia; in fact they should say *partially* saturate, for it is of great importance that a certain excess of acid should remain. It is worth considering whether finely pulverised bone ashes would not be better than chalk or quicklime to saturate the residue; the soluble phosphates produced would of course greatly add to the value of the resulting manure. The evaporation must, of necessity, be conducted with extreme care, for if it were attempted to evaporate ammoniacal salts to dryness by the process used for carbonate of soda, there would be great danger of volatilisation of the ammonia in spite of the presence of an excess of sulphuric acid.

There appears to be a mania among some persons for taking out patents. It is absolutely marvellous to observe the extraordinary things which some people consider worth the expense of a patent. There is, however, method in the madness of some of these patentees of queer processes. We have, before now, studied hard in the endeavour to extract something definite from the mass of technical verbiage with which a patent has been crammed, and we have been inclined to consider the patentee as having no distinct aim, until we have seen, sometime after, actions for infringements of the very patents we have fancied to contain nothing definite. This is, in fact, the true secret of such patents; they are taken out solely with the view of affording a pretext to claim damages from persons using processes which can be made to appear infringements. The above remarks are not intended specially to apply to any patent or patents noticed in this number of our journal.

CORRESPONDENCE.

Chemical Nomenclature.

To the Editor of the Chemical News.

Sir,—In your recent numbers I see that there has been some discussion upon the chemical nomenclature, and if too much has not already been said on the subject, I would beg to offer a few remarks. It must be acknowledged that the present nomenclature is very deficient, and that an entire change would be inconvenient if not almost impossible at the present moment; this will come in time, but I think that in the term nitrate of potassium, which after all is not so very different from the old name of nitrate of potassa, the ending *ate* is quite sufficient to indicate that the above-mentioned body contains a compound oxygenated radical NO_6, which replaces the chlorine in chloride of potassium, without introducing the semi-barbarous names of nitrationide

or nitrionide of potassium, which I believe was first introduced by Mr. Daniell; and it would require a much smaller exertion of the memory to understand that the terminations *ate* and *ite* show the existence of oxygenated radicals capable of replacing oxygen and chlorine, than to learn an almost new nomenclature. Thus a chloride contains the radical Cl, a chlorite the radical ClO_4, and a chlorate the radical ClO_6.—I am, &c.

H. M'Leod.

Salt Efflorescences.

To the Editor of the Chemical News.

Sir,—Having, at different times, examined several samples of "salt efflorescences" from buildings near the sea, I can fully corroborate the statement of Mr. Wentworth L. Scott, in your impression of the 24th, as to their composition. I have invariably found them to consist of sulphate of sodium, nearly pure, with only slight indications of lime or magnesia, very little chlorine, and no trace of nitric acid.

From numerous inquiries as to the ingredients composing the mortar or cement in these cases, I have been led to consider this salt as derived from the sea sand so extensively employed here; indeed, I have never found it on a building where any other sand was made use of.

From its efflorescent nature, it is only seen on fine dry days; the least approach of damp weather causes its rapid re-solution and absorption; indoors this alternation may go on for ten or twelve years, defying paper, paint, or any other covering; but exterior walls, I am informed, get rid of it in two or three years from exposure to the attrition of winds, fall of rain, and other atmospheric influences. It makes its appearance on cement much sooner than on mortar, in consequence of the quick drying properties of the former. It is also seen to a small extent on bricks prepared with sea sand; some of these were used in the construction of the Crystal Palace, and it becomes an interesting question whether sea sand also entered into the composition of the cement or plaster employed in the Pompeian and other courts. I may mention that, when plastering with plaster of Paris, the builders here are very careful to use only land sand, to avoid the increased efflorescence.

Perhaps Mr. Scott will state, if possible, whether the samples he examined could be attributed to what I consider to be their sole origin—the sea sand.—I am, &c.

E. C. C. Stanford, F.C.S.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Acichloride of Selenium and Alum of Selenic Acid.—The acichloride of selenium is produced by the action of chloride of selenium on selenious acid. The two are heated together in a closed tube bent at right angles. The acichloride is volatised and condensed, and any excess of selenious acid is left at the lower end of the tube. Weber[1] describes the acichloride as a yellowish liquid fuming in moist air, having the sp. gr. 2·44, and boiling about 220° C. Its composition may be expressed by the formula $SeCl_2 + SeO_2$, according to which it will be represented as a combination of selenious chloride and selenious acid. The composition may be also expressed 2(SeClO), representing the selenious acid, in which 1 atom of O is replaced by 1 atom of Cl; or a selenious chloride in which 1 atom of Cl is replaced by 1 atom of O. Wurtz remarks[2] that the acichloride of selenium is evidently the analogue of the chloride of thionyle, which Schiff obtained by the action of perchloride of phosphorus on sulphurous acid, and he thinks it likely that the chloride of selenyle (acichloride of selenium) would be formed under the same circumstances.

[1] *Poggendorff's Annalen*, Bd. cviii. s. 613.
[2] *Répert. de Chimie*, Mars 1860.

Alum of Selenic Acid.—Mitscherlich has observed that the sulphates and seleniates are isomorphous, and resemble each other so much in their properties that they can only be distinguished by separating the selenium. This would lead us to suppose the existence of double seleniates corresponding to the alums. Weber has succeeded in forming beautiful crystals of seleniate of potash and alumina exactly resembling those of ordinary alum. He obtained these by neutralising 1 part of selenic acid with carbonate of potash, and 3 parts with pure hydrate of alumina. He then poured the two solutions together and allowed them to evaporate spontaneously. The crystals are more soluble in water than those of common alum. At a dull red heat the selenic acid combined with the alumina is completely driven off.

Solubility of Silica in Alcohol mixed with Hydrochloric Acid.—Winkler[3] observes that when Portland cement slag from furnaces, olivine, or other pyrogenous silicates in fine powder are added to alcohol saturated with hydrochloric acid, the silica is dissolved, and a transparent mobile liquid is obtained. The author supposes that this is a consequence of the silica absorbing the elements of alcohol, which in that case replaces water of crystallisation. Wurtz[4] thinks that silica, like the other acids, may be etherified under the influence of a mixture of alcohol and hydrochloric acids.

Nitride of Chromium.—Ufer[5] points out that nitride of chromium, prepared according to Schrötter's process, at a dull heat has the remarkable property of decomposing ammonia into its elements. Heated in the air it is changed into the green insoluble oxide of chromium. When fused with potash or carbonate of soda it is not acted on. Alkaline hypochlorites disengage nitrogen and form alkaline chromates. Heated with oxide of copper or minium it burns with a red flame and disengages nitrogen. Nitrate of potash decomposes it with violence, causing an evolution of nitrogen, and the formation first of oxide of chromium, and then of chromate of potash. Chlorate of potash acts still more violently. It is not acted on by hydrofluoric acid. Chlorine disengages nitrogen and changes it into chloride of chromium. Hydrochloric acid at a red heat changes it into the violet chloride of chromium and chloride of ammonium. Long exposure to heat in a covered crucible decomposes it.

Aceto-nitrates of Iron.—M. Scheurer-Kestner writes[6] that when ferrous acetate is boiled with an excess of acetic acid and nitric acid it is rapidly oxidised; but the quantity of nitric acid required is double that indicated by the equation:

$$2FeO.C_4H_3O_3 + C_4H_3O_3 + NO_5 = Fe_2O_3.3C_4H_3O_3 + NO_2.$$

When the solution is sufficiently concentrated by evaporation the bottom of the vessel becomes covered with needles of a blood red colour, which may be purified by washing with ether, and solution in boiling water. Their analysis conducts to the formula:

$$Fe_2O_3.NO_5.2C_4H_3O_3.6HO.$$

An aqueous solution of this salt is decomposed by boiling into nitric acid, acetic acid and oxide of iron. Another equivalent of nitric acid added to the preceding salt gives crystals of a deeper colour, the analysis of which does not lead to a rational formula.

By the action of acetic acid on the soluble basic nitrate of iron $Fe_2O_3.2NO_5$, small prisms are obtained whose composition is represented by the formula:

$$Fe_2O_3.2NO_5.C_4H_3O_3.3HO.$$

Compound of Bichloride of Sulphur and Perchloride of Iodine.—By passing a current of chlorine for a long time over a mixture of one part of iodine and two parts sulphur, M. Jaillard obtained a liquid which deposited beautiful transparent prismatic crystals of a reddish-yellow colour. They were extremely deliquescent and de-

[3] *Chem. Centralblatt*, Bd. iv. s. 673.
[4] *Répertoire de Chimie.*
[5] *Annal. der Chemie und Pharm.* Bd. cxii. s. 281
[6] *Répert. de Chim.* Déc. 1859.

composed with violence when brought in contact with water. In the presence of alcohol or ether they produced a great evolution of gas, hydrochloric acid and etherial vapours, the mixture became hot, and on cooling there only remained a little sulphur and protochloride of iodine. With sulphide of carbon, the bichloride of sulphur is separated, and the perchloride of iodine decomposed, the iodine remaining in solution, and the chlorine giving rise to the formation of a chlorosulphide of carbon.

The analysis of the crystals yielded M. Jaillard results which show that their composition is expressed by the formula $SCl + ICl_3$.[7]

II. ORGANIC CHEMISTRY.

Researches on Acetone.—In examining the liquids which remain after having submitted rough acetone to a temperature above 130°, M. Fittig could only obtain a single body with clearly defined properties. It is an oil identical with phorone $C_{18}H_{14}O_2$, which Gerhardt and Lies had discovered among the products of the dry distillation of camphorate of lime. Fittig obtained this body by submitting the residus of acetone to a series of fractional distillations and reserving the product passing between 200° and 205°. Its identity with phorone was established with great care. The author has, among others, obtained one of the most interesting products of the decomposition of phorone, viz. cumene, $C_{18}H_{12}$, which shows the possibility of preparing benzoic acid with acetic acid.[8]

Composition and Mode of Production of Gum. M. Frémy[9] has discovered that gum is a salt composed of an acid, which he calls *gummic* and lime. Gummic acid, he says, is derived from *metagummic* acid. The metagummic acid is isolated by pouring some thick solution of gum into sulphuric acid. The two are left together for some hours, when the metagummic acid is found on the top, forming a sort of membrane, which is insoluble even in boiling water. When heated, however, with traces of lime, soda, potash, or ammonia, it dissolves immediately, and remains in combination with the base, reproducing the gum. The insoluble part of cherry tree gum (cerasine) is acted on by alkaline carbonates, and gums are produced exactly resembling those obtained directly by the action of bases on metagummic acid. Dilute and cold acids decompose cerasine and eliminate the metagummic acid, which by the action of lime produces gum arabic. Cerasine then is a compound of lime and *metagummic* acid.

Bassora gum contains a substance analogous to but not identical with metagummic acid. With the alkalies and alkaline earths it forms gummy substances, soluble in water, insipid, uncrystallisable, and insoluble in alcohol like gum arabic, but precipitable by acetate of lead, which gum arabic is not.

III. ANALYTICAL CHEMISTRY.

Influence of Fatty Bodies on the Solubility of Arsenic.—In a long communication[10] M. Blondlot relates that a great number of experiments have shown him that the least contact of arsenious acid with a fatty body reduced the solubility of the arsenic in several liquids to the fifteenth or twentieth of what it otherwise would have been. He also confirms the efficacy of oily mixtures (such as was mentioned at p. 71, CHEMICAL NEWS) in the treatment of arsenical poisoning.

SCIENTIFIC NOTES AND QUERIES.

Electrical Decomposition of Compounds of Nitrogen.—SIR,—The discrepancy observed by your correspondent *E. G.* between the statements of Faraday and Grove as to the decomposition of nitrogen compounds, arises from his not distinguishing between the two forms of electricity, *static* and *dynamic*. "Ammonia, protoxide of nitrogen, &c. are decomposed by the *discharge*;" that is, by the passage of *sparks* of electricity of tension, proceeding either from a frictional machine or a Ruhmkorff coil (see CHEMICAL NEWS, p. 8). This effect is generally considered to be due to the *heat* of the discharge, or to be virtually a decomposition by ignition. Professor Faraday must either have expressed his meaning imperfectly or been incorrectly reported, since voltaic electricity *does* liberate nitrogen from many of its compounds (*e. g.* ammonia, nitric acid). The nitrogen, however, does not pass uniformly to either pole, and is only set free by the action of nascent oxygen or hydrogen, arising from the decomposition of water simultaneously present. Hence, in Faraday's language, nitrogen is not an "ion," and its compounds are said to be incapable of electrolytic decomposition in the stricter sense.—*F. W. G.*

Estimation of Carbon by Combustion.—SIR,—In burning, according to the usual method, a compound of an organic acid with a strong base, such as potass, a portion of the carbon remains in the combustion tube as an alkaline carbonate. How may the process be best conducted so as to avoid such a result?—*E. G.*

MISCELLANEOUS.

A Doctor and his Assistant.—Eugène Coulon, a man who once made some noise in Parisian society died recently in the Rue St. Honoré. He was born towards the end of the last century, and was the son of a provincial chemist. He came to Paris to study medicine, but he possessed great talents as a mimic, and in that way made his fortune. Coulon had been recommended to Alibert, by whom he was much liked, and whom he often accompanied in his visits to his patients and to his hospital. Alibert sometimes exercised his art in a singular way. At his hospital he would sometimes stand at the door of a ward, glance at all the beds, and without entering point to each occupant one after the other, saying, "ipéca, ipéca, ipéca," as many times as there were beds in each room. And ipecacuanha was given to each patient. At the next ward he would do the same thing, only changing the remedy. Coulon was so thoroughly master of the peculiarities of Alibert that he too would sometimes show himself at the door of a ward, and imitating the voice, the face, and the manner of his patron would say, "ipéca, ipéca, ipéca," so that when Alibert himself arrived the nurses would say, "Doctor, you have already made your visit." And Alibert would depart astonished that he had forgotten the fact.—*Athenæum.*

Malleable Iron.—A new and improved method of malleable-ising iron castings is announced in the New York *Tribune* to have been discovered by Professor A. R. Eaton of this city. It consists in exposing the castings to the contact of oxide of zinc, as a substitute for the oxide of iron in the furnace. It is stated that the employment of the oxide of iron which combines with the excess of carbon in iron castings, when long exposed to a red heat, leaves a spongy residium on the castings, which is obviated by the zinc oxide, because the zinc is volatile and passes off, leaving the oxygen gas to combine with the carbon in the iron.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A Subscriber (Paisley).—Certainly; but the proportion varies according to circumstances, and can only be told by an analysis. It is usually from 50 to 60 per cent.

A Beginner.—All can be obtained at Knight's in Foster Lane. The price of Hemming's jet is 10*s*. we believe, and Daniell's something more. Platinum is sold by weight, and the price is now about 32*s*. per ounce.

Tyro is thanked; we did not see the paragraph, but will look for it.

W. J. J.—You must have a license for your still, and you will be under the supervision of the excise. Rice we believe has been used and found more expensive than corn. Thomson's is still the best book on the subject.

An Engineer.—The steel is heated to the temperature at which the blue tint is assumed, and then suddenly cooled.

M. A. B.—The work will receive early attention.

E. G.—Received and in type.

W. G.—Received.

*** All *Editorial Communications* are to be addressed to Mr. CROOKES, and *Advertisements* and *Business* communications to the PUBLISHER, at the Office, 12 and 13 Red Lion Court, Fleet Street, London, E.C.

[7] *Journal de Pharm. et de Chimie*, Mars 1860.
[8] *Annal. der Chem. und Pharm.* Bd. cxii. s. 309.
[9] *Comptes-Rendus*, t. l. p. 124.
[10] *Ibid.* p. 165.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks upon the various Methods usually adopted for the Separation of the Alkalies from the Bases with which they are generally associated in Soils, Minerals, &c. by FREDERICK FIELD.

(*Continued from p. 194.*)

IN continuing the recapitulation of the various processes usually adopted for the estimation of the alkalies in minerals, &c. it will also be useful to point out one or two methods of great excellence which do not appear to be so generally employed as their merits would lead us to expect. The action of caustic baryta has already been discussed, and the disadvantages attending its use are not lessened by the employment of the nitrate, and are even augmented by that of the carbonate. Dr. Lawrence Smith, in an investigation upon this subject, first published in Silliman's *American Journal*, and reprinted in the *Chemical Gazette*, has done much in facilitating the fusion of the various silicates containing alkalies, and shown that by adopting certain methods the difficulties attendant upon this class of investigation can be exceedingly lightened, and the decomposition of the alkaline silicates very greatly facilitated. As the processes he adopts are now generally known, it will be merely necessary to consider their leading features and characteristics.

Dr. Smith first tried the fusion of the mineral under examination with carbonate of lime and fluor spar. Carbonate of lime *per se* acts with considerable energy upon the silicates, as it parts with its carbonic acid much more readily than the carbonate of baryta, the only obstacle to its use being the employment of a very intense temperature. Mixed with fluoride of calcium, which merely acts as a flux, the mineral and the lime are brought into intimate contact, and the difficulty is, to a great extent, removed.

The substance to be examined, finely pulverised, is mixed with from four to five parts of pure precipitated carbonate of lime and its own weight of fluor spar, and introduced into a platinum crucible capable of holding three times the bulk of the mixed powder. It is then exposed, with the usual precautions, to a bright heat for three quarters of an hour.

By this means Dr. Smith found that the most refractory silicates were entirely decomposed. After cooling, the contents of the crucible are digested with one part of hydrochloric acid and two of water, until dissolved, and carefully evaporated to dryness, an operation far easier than after the soda fusion, as the evaporation proceeds more quietly and without decrepitation. A little hydrochloric acid is added to the dry mass, and subsequently water, when heat is applied, and the liquid boiled for a few minutes. A slight excess of concentrated solution of carbonate of ammonia is introduced, and the precipiate, which is allowed to subside, is filtered off. The solution contains chlorides of ammonium, magnesium, and a little chloride of calcium, and is then partially evaporated on a sand bath.

In order to avert the great inconvenience which is always experienced in the evaporation of the solution of chloride of ammonium, Dr. Smith takes advantage of a fact described by himself some short time previously, viz. the decomposing effect produced by heating sal-ammoniac with nitric acid. About three parts of nitric acid are added to every one of sal-ammoniac present, the solution warmed gently, and below the temperature of boiling water decomposition, accompanied with considerable evolution of gas, takes place with great rapidity. By this means much trouble is avoided, and the evaporation proceeds quickly and rapidly; when dried, the residue is dissolved in a little water, lime water is added, the liquid is boiled and filtered, the filtrate treated with carbonate of ammonia to separate the lime, and again evaporated to dryness. Dilute sulphuric acid is now added, the nitric and hydrochloric acid expelled by heat, and the alkalies left in the state of sulphates. For the conversion of the sulphates into the chlorides, Dr. Smith prefers the acetate of lead to chloride of barium; this reagent is added in slight excess, in order to precipitate the whole of the sulphuric acid; the filtrate, after warming, is treated with sulphuretted hydrogen, the sulphide of lead removed by filtration, excess of hydrochloric acid added to the acetates of the alkalies, and the liquid evaporated to dryness. This process, although excellent, has since been improved by the same chemist. Dr. Smith found that silicates could be fused still more easily by mixing them, in a finely divided condition, with rather more than 0·5 their weight of chloride of ammonium and 5 to 6 of carbonate of lime. After forty minutes strong heat in a platinum crucible the mineral is entirely decomposed. "There is no silicate," observes Dr. Smith, "which, after having undergone this process, is not easily dissolved by hydrochloric acid."

But perhaps the most important point in this method is the facility with which the alkalies can be at once separated from the other bases without subjecting the solution to numerous processes before these bodies can be obtained in a state for estimation. After the mineral or other product under examination is perfectly decomposed by fusion with the required proportions of carbonate of lime and chloride of ammonium, the mass is heated with water until thoroughly disintegrated, when it is thrown upon a filter and thoroughly washed. The filtrate contains merely the chlorides of the alkalies, a little chloride of calcium, and caustic lime. A small quantity of carbonate of ammonia is added to precipitate the two latter substances, the carbonate of lime separated by filtration, the filtrate evaporated and gently ignited; the alkalies remain as chlorides.

Few processes in chemistry can be simpler than this. The potash and soda are both brought into a soluble condition, and are easily and satisfactorily removed from the other bases.

As far as my own experience extends, Smith's method

is very superior to that proposed some time ago by Wurtz, viz. the decomposition of siliciferous mineral by means of chloride of barium, or a mixture of that salt with chloride of strontium. I have tried few experiments with the mixture just alluded to, but have found great difficulty in decomposing silicates by the simple admixture of chloride of barium.

In the beginning of this short notice the disadvantages of a very high temperature when caustic baryta was employed were pointed out, although in some very refractory silicates there is no doubt an intense heat is occasionally required for their perfect decomposition, even at the risk of endangering the crucible. But in soils and most metallurgic products, slags, &c. no very prolonged action or excessive degree of heat is necessary. In two equal quantities of the same soil, one mixed with four times its weight of caustic baryta, and the other with four times its weight of chloride of barium, and each subjected for five and twenty minutes to a gas flame urged by bellows, the former was found to be entirely decomposed, becoming perfectly soluble in hydrochloric acid, and after evaporation forming a clear transparent jelly, whilst the latter, on the addition of dilute acid, left a large deposit of undecomposed mineral. There is no doubt whatever that by a more prolonged action all the earthy matter would have been decomposed by the chloride of barium, but as far as I can see, in ordinary cases of analyses, this substance has no superiority over caustic baryta. The mixture of the chlorides of strontium and barium is doubtless far more fusible than the latter *per se*. The last portion of Dr. Smith's method appears somewhat tedious. The decomposition of the nitrates and chlorides of the alkalies into sulphates, the addition of acetate of lead for the formation of soluble acetates and an insoluble sulphate, and the separation of the lead by hydrosulphuric acid. If oxalic acid were employed to the mixed chlorides and nitrates, an entire decomposition of the latter would occur, and also if the former by more prolonged action, which is however needless, as the alkaline metals are required in the state of chlorides. One or two digestions with a strong solution of oxalic acid, evaporation and ignition, would yield a mixture of the carbonates and chlorides which of course could be immediately converted into the latter without the aid of hydrochloric acid.

Schaffgotsch, quite recently, assures us that a slight excess of caustic ammonia added to a solution of sesquicarbonate of that alkali completely separates magnesia as a crystalline precipitate, having the formula $NH_4O.CO_2+MgO.CO_2+4HO$, a compound requiring 60,000 parts of the precipitant for its solution, and leaving 15·6 per cent. of residue after ignition, which, if the above formula be correct, would be pure magnesia. The author recommends the separation of magnesia from the alkalies by this way, but should the compound be soluble in chloride of ammonium, this body would have to be expelled before the addition of the sesquicarbonate.

In concluding the foregoing brief criticisms upon the various modes of separating the alkalies from other bases in siliciferous compounds, nothing strikes me as so important as the method proposed by Dr. Smith, for extracting the alkalies from the fused mass by aqueous solution; thus freeing them at once from the great bulk of the other earthy bases. There is little novelty in this, as that chemist observes, as Fuchs long ago used a similar method for extracting lithia from lepidolite, and many methods have been proposed, and some adopted for the extraction of potash on the large scale, by fusing felspathic or other rocks, rich in that alkali, with lime or carbonate of baryta, and subsequent digestion with water.

Now in chemical analysis when caustic baryta is employed for the decomposition of the silicates (provided the decomposition be perfect), it would appear that the alkalies could be entirely extracted by water alone, without the aid of an acid whereby other bases are dissolved, and have again to be separated from those which are sought after. The filtration would certainly be long, as the slowly soluble baryta would cause an alkaline solution to pass through the filter for a considerable period, and until the last trace of alkalinity has disappeared no certainty can be attached to the removal of the last traces of potash or soda. This could be overcome, nevertheless, by the conversion of the baryta into carbonate by a current of carbonic acid, which would not interfere with the solubility of the alkalies. Experiments, I believe, are required to guarantee the methods just proposed. I am not aware at least of any investigations upon this particular subject.[1]

TECHNICAL CHEMISTRY.

On the Use of Lime as a Disinfectant of Sewage; and on the Necessity for and Advantages to be obtained from Perchloride of Iron.

Drs. Miller, Hofmann, and Frankland have addressed a report on the above subject to the Metropolitan Board of Works, from which we extract the following:

By the use of lime and chloride of lime, as was practised during the course of last summer, there can be no doubt that the state of the river was decidedly improved. The temperature of the river was for a whole month above the hottest point which it attained in the previous summer, the rainfall of the preceding autum and winter was decidedly deficient, and the quantity of sewerage matter was greater than in former years, yet according to the testimony of many who made it their particular object to observe this point, the offensive condition of the river was mitigated.

Considering that the pollution of the river is annually increasing, owing to the gradual conversion of cesspools into waterclosets, and the extension of the system of drainage, they are decidly of opinion that some means ought to be adopted with a view of endeavouring to mitigate the offensive condition of the river in hot weather.

The lime and chloride of lime were at the time they were employed last year the best deodorising agents that could be obtained in sufficient quantity, and at reasonable cost to supply the demand which suddenly arose.

During the summer a careful investigation was made upon the use of perchloride of iron. These experiments pointed out this agent as the one which, taking all circumstances into consideration, is best adapted to operations of such magnitude.

These experiments, however, were made with stagnant sewerage products, confined in tanks, in a manner corre-

[1] In allusion to the separation of magnesia from the alkalies by means of oxalic acid, it appears from a paper published in *Poggendorff's Annalen*, xcv. p. 401, and *Chem. Gazette*, xiii. p. 357, that Weeren evaporates the ammonical solution of the alkalies and magnesia, freed from lime by oxalate of ammonia, to dryness, raises the temperature gradually to a red heat, with the previous addition of dry carbonate of ammonia, and washes out the carbonates of the alkalies. In this case however they were dissolved originally in nitric acid, and the solution was free from hydrochloric acid. Weeren also adopts the method of Deville, who adds crystals of oxalic acid to the ignited mass, and again raises the substance to a red heat.

sponding to that in which the matters will have to be dealt with when the system of main drainage, at present in process of construction, is completed. The perchloride proved perfectly successful under these circumstances in arresting putrefaction for at least nine days during the hot period in July last; but it must be borne in mind that the conditions under which the perchloride can at present be applied are essentially different, since it must be mixed with the liquids whilst they are flowing through the sewers.

Nevertheless, there is every reason to expect that the application of perchloride of iron to the contents of the sewers as they flow outwards will be attended with a benefit greater than that which was found to be the result of the use of the chloride of lime in the course of last summer.

They are further of opinion that in order to derive full benefit from the use of this, or of any other deodorising agent, its application at the outfall of the sewers should be commenced some weeks before the hot weather sets in; not later, for example, than the 1st of May.

In conclusion, they wish to state distinctly that they believe that the use of perchloride of iron will effectually arrest the putrefaction of the matters daily contributed by the sewers, and go far towards reducing the condition of the river to that in which it would be if the sewerage products were for a time diverted. But they do not anticipate that the use of the perchloride, or indeed of any other disinfecting agent, in the only manner which is at present practicable, will altogether prevent decomposition in the body of water and mud already in the river.

PHARMACY, TOXICOLOGY, &c.

On some of the Chemical Reactions of Strychnia, by T. G. Wormley, *M.D.*

In the following paper it is proposed to give the result of some experiments in regard to the relative value of the various tests which have been proposed for the detection of strychnia.

The various solutions were made with great care from pure strychnia, generally dissolved in just sufficient quantity of dilute acetic acid, and the reagents were generally applied by means of a glass rod dipped in a saturated solution of the reagent, to a *single drop* of the strychnia solution, delivered upon a glass side, from a graduated burette which furnished a grain of fluid in each drop. Therefore, each drop contained an amount of pure strychnia, corresponding to the fractional dilution of the solution.

To prevent repetition in giving the various tests, the amount of strychnia operated upon will frequently be stated simply in the form of a fraction, it always being understood to imply the fractional part of a grain of strychnia, in one grain of water.

1. Ammonia.—1. $\frac{1}{100}$th grain of pure strychnia in one grain of water, gives with ammonia an immediate white precipitate, at first amorphous, but very soon it begins to assume a crystalline form, and in about three minutes the drop becomes a solid mass of lengthened prisms.

2. $\frac{1}{500}$ gives no immediate precipitate, but in a few seconds beautiful stellate crystals begin to form, which very soon become abundant.

3. $\frac{1}{1000}$ behaves much the same as 2—not so abundant.

4. $\frac{1}{2000}$, with the microscope, crystals begin to form in about a minute; in three minutes they are very obvious to the naked eye. If the drop be rubbed with the glass rod, rings of granules are very obvious to the naked eye in a few seconds, and the ppt. is much more abundant than when not thus treated.

5. $\frac{1}{5000}$, no indication after stirring for several minutes, except when viewed with the microscope, a few granules appear.

From the above, the limit of the test, when applied to a single drop, is when it holds in solution $\frac{1}{2500}$th its weight of strychnia.

2. Potash.—This reagent behaves much the same as ammonia, its limit being about the same. In applying this test it is very important that the proper quantity of the reagent be added, for if either too much or too little, no ppt. will be produced.

3. Carbonate of Potash.—1. $\frac{1}{100}$th grain of strychnia gives an immediate white precipitate of star-like crystals, which will redissolve if a sufficient quantity of the reagent has not been added.

2. $\frac{1}{500}$, in a few seconds small granules, prisms, and a few star-like crystals begin to form, which soon become rather abundant.

3. $\frac{1}{1000}$, in a few seconds lengthened granules may be observed with the microscope in a few minutes they are obvious to the naked eye.

4. $\frac{1}{2000}$, after a few minutes small granules are very perceptible.

5. $\frac{1}{5000}$, after several minutes, no indication with the microscope.

4. Carbonate of Ammonia.—In $\frac{1}{100}$ and $\frac{1}{500}$ solutions, the same results as with carbonate of potash. In a $\frac{1}{1000}$th solution, no indication after 15 minutes.

5. Iodide of Potassium.—1. $\frac{1}{100}$th, solution in a few seconds gives a white crystalline ppt. of tufts of long prisms.

2. $\frac{1}{500}$, it is several minutes before crystals begin to form; if the solution be stirred, however, they begin to appear in about 2 minutes.

3. $\frac{1}{1000}$, by stirring, crystals begin to appear in about 5 minutes.

4. $\frac{1}{2000}$, crystals begin to appear in about 7 minutes.

5. $\frac{1}{5000}$, with the microscope crystals can be seen in 10 minutes, in about 20 minutes they are just perceptible to the naked eye.

6. Sulphocyanide of Potassium.—1. $\frac{1}{100}$, gives an immediate mass of white crystals.

2. $\frac{1}{500}$, in a few seconds the crystals are very abundant.

3. $\frac{1}{1000}$, by rubbing, in a few minutes crystals begin to form.

4. $\frac{1}{2000}$, after several minutes, a few crystals may be observed upon the border of the drop with the microscope.

7. Tannic Acid.—1. $\frac{1}{1000}$, gives an immediate white curdy precipitate.

2. $\frac{1}{2000}$ gives very satisfactory results.

3. $\frac{1}{3000}$, after a few minutes the ppt. is quite perceptible.

4. $\frac{1}{4000}$, after several minutes it is just possible to observe a white cloudiness.

The satisfactory limit of the test is when it is applied to a drop of fluid holding in solution $\frac{1}{2500}$th its weight of strychnia. The ppt. is very soluble in acetic acid; and if obtained from dilute solutions, it is also soluble in a drop of potash, giving a red liquid; but when produced from strong solutions, the ppt. will not all dissolve in a drop of potash solution.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, 30 *March* 1860.

On Acids and Salts, *by* Wm. Odling, *Esq.*, *M.B. F.R.S. Honorary Secretary of the Chemical Society.*

Lord Wensleydale *in the Chair.*

I do not conceal from myself that the story I have to tell you this evening is of a somewhat abstract and complicated character; but, favoured with your kind attention, I do not despair of making it interesting to you. I say this to dispel any alarm which the array of diagrams behind me might possibly induce in your minds. The subject I have undertaken to bring under your notice is one of so extensive a nature, that I can hardly venture to occupy much of your time with preliminary considerations. I think it necessary, however, to make a few remarks upon the position from which I propose to regard my subject, and consequently the position from which I wish you to regard it. In the early period of modern organic chemistry what is called the electro-chemical theory was in full authority: every chemical compound was a dual compound, it was either a binary compound, or was made up of two or more binary compounds. Thus lime was a binary compound of calcium and oxygen, sulphuric acid was a binary compound of sulphur and oxygen, and this body, sulphate of lime, was made up of the two binary compounds lime and sulphuric acid; and so it was with all compounds at that time known to chemists. Now this electro-chemical theory, although quite inadequate to explain many phenomena, and only adapted to others by being subjected to most vigorous and remorseless contortions, answered the purpose of mineral chemistry pretty well on the whole, and was useful in its day by enabling chemists to associate a great number of different compounds under one common point of view. It was natural therefore that chemists, deciphering the unknown by the known, should, in their earliest attempts to penetrate into the recesses of organic chemistry, have relied upon this selfsame theory as the great and only exponent of all mysteries of composition. In accordance with these views alcohol was represented to be a combination of oxide of ethyl, or ether, with oxide of hydrogen, or water; it was in fact the hydrated oxide of ethyl, precisely as slacked lime was the hydrated oxide of calcium; and similarly the ethers were represented to be salts of the oxide of ethyl, precisely as lime salts were represented to be salts of the oxide of calcium. So far there was no great harm done: alcohol and the ethers, although very different from hydrated bases and salts, have certain properties in common with them, and are capable of undergoing certain more or less of analogous reactions. But in many of its applications, and particularly in reference to what are now called substitution compounds, the electro-chemical theory failed altogether, even in the hands of its most accomplished expounder, the great Berzelius. Let me give you one or two instances of its failure. Here is the formula written up for indigo $C_{16}H_5NO_2$; now when this blue indigo is acted upon by oxidising agents, that is substances capable of giving up their oxygen, it becomes converted into a crystalline body of a yellowish red colour known as isatin. We have here in this vessel a solution of indigo, and if we add to the indigo some nitric acid, the nitric acid being an oxidising agent oxidises the indigo. The colour you see is disappearing, and that which was blue indigo has become yellow isatin. Now isatin differs in composition from indigo in this particular, that whereas indigo only contains two atoms of oxygen, isatin contains four. In this table I am purposely using the atomic weights of Berzelius. Now when isatin is acted upon by chlorine, it loses one of its hydrogen atoms and acquires an atom of chlorine in exchange, so as to become chlorisatin, and this, when further acted upon by chlorine loses another atom of hydrogen and gains another atom of chlorine so as to produce bichlorisatin. These three bodies, isatin, chlorisatin, and bichlorisatin, although so different in composition, present the most remarkable similarity to one another; you cannot distinguish them by sight, and nothing less than an ultimate analysis, utterly breaking up the compounds, can identify them one from the other; they are all three yellow-red bodies, they all crystallise in the same form, they are all insoluble in water, they are all soluble in alcohol, and all unite with alkalies to form corresponding salts. Now the formulæ here adopted

Chlorine Substitution.		
$C_{16}H_5$	NO_2	Indigo.
$C_{16}H_5$	NO_4	Isatin.
$C_{16}H_4Cl$	NO_4	Chlorisatin.
$C_{16}H_3Cl_2$	NO_4	Bichlorisatin.

show the relation of these bodies to each other, but, according to the electro-chemical theory, which professed to explain their real nature, they were represented as follows.

$C_{16}H_5N.O_4$	Oxide of Inden.
$C_{16}H_4N.O_3 + ClO$	Basic Hypochlorite of Porrinden.
$C_{16}H_3N.O_3 + 2ClO$	Neutral Hypochlorite of Flavinden.

Isatin was a binary compound of oxygen and inden, the first substitution product was a basic hypochlorite of porrinden, and the second substitution product, a neutral hypochlorite of flavinden. The first was an oxide of inden which no one had ever seen, the next was a hypochlorite of porrinden, which no one had ever seen, and the third was a hypochlorite of flavenden, a body equally hypothetical with its two predecessors. I may take another illustration from the oil of bitter almonds, or benzoic aldehyd, $C_{14}H_6O_2$. If you act upon this body with chlorine you take out one of the hydrogen atoms, and introduce in its place an atom of chlorine so as to get the body chloro-benzoic aldehyd, $C_{14}H_5ClO_2$. Now how do you think these two bodies were represented by the electro-chemical theory? The first by the formula $C_{14}\ H_5\ O + HO$, and the second by the formula $2\ (C_{14}\ H_5.\ O_3) + C_{14}\ H_5\ Cl_3$, which last body, $C_{14}\ H_5\ Cl_3$, has not been seen up to the present day. But the discoverers of chloro-substitution would not allow organic chemistry to be simplified in this fashion. The electro-chemical theory had failed egregiously in reference to chlorine substitutions; it had proved inadequate to explain and associate the multitude of new results so unceasingly produced, and had to give way to the theories of substitution, of types of decomposition, of organic series, and of multequivalent radicles, by the aid of which we are enabled in the present day to explain the relations and composition of those numerous complicated bodies by which the domain of organic chemistry has been so continuously enriched. Seeing, then, the light which these modern views have thrown on bodies whose constitution the electro-chemical theory left completely in the dark, it was only natural to inquire whether these selfsame views might not throw some additional light on the simpler compounds of mineral chemistry, and particularly upon those compounds known as acids and salts which have hitherto constituted the strongholds of electro-chemistry. Now it is to this inquiry I propose to direct your attention this evening. I wish to illustrate to you the nature of our old acquaintances, the mineral acids and their salts, by the light of modern doctrines. And I think I may venture to enlist your sympathies so far as to say that these doctrines are likely to have considerable permanence. Doubtless they will be absorbed in a higher generalisation, but so far as they go, they are, I believe, true; they are theories of observation rather than theories of causation, to be compared rather with Kepler's laws of planetary motion than with Newton's theory of gravitation.

The two principal laws or doctrines of which I shall avail myself this evening have reference to series and substitutions. Now the doctrine of series amounts to this, that if you search out among the immense number of bodies known to chemists, you will find a great number which are capable of being arranged in a series, the successive members of which differ from each other in composition by a

common increment, and that the bodies thus associated in composition are also associated by certain relations in their properties. We have homologous series, isologous series, and various other series, all differing from each other in the nature of their increments; but, in any series of bodies differing from one another by a common increment of composition, we find a distinct relation in properties, the nature of the relation varying with the nature of the series.

Now with regard to substitution, chemists admit at the present day that in the greater number of instances it is not possible for them to ascertain the arrangement of the atoms which enter into the constitution of a compound. Hence they no longer represent alcohol as the hydrated oxide of ethyl; at any rate not as a statement of its actual constitution. But they admit that it is very readily possible to know that the arrangement of the atoms in a certain compound is the same as that in some other compound derived from it by equivalent substitution.

Thus I have here a solution of oxalic acid; if to that solution I add a solution of a salt of copper, I get an abundance of a pale green precipitate. The formula for oxalic acid is $C_2H_2O_4$, and the formula of the green precipitate, which is oxalate of copper, is $C_2Cu_2O_4$. They differ in this, that the two atoms of hydrogen in the oxalic acid do not exist in the oxalate of copper, but are replaced by the two atoms of copper. Oxalate of copper is a substitution product of oxalic acid. Again, we have here the formula for benzoic acid, $C_7H_6O_2$, and also that for benzoate of sodium, $C_7H_5NaO_2$, obtained by abstracting an atom of hydrogen from benzoic acid, and supplying its place by an atom of sodium. If we act upon this benzoate of sodium by means of chlorine gas, we get a certain action which results in the production of chlorobenzoic acid, $C_7H_5ClO_2$, a compound that differs from benzoic acid in this particular, that benzoic acid has six atoms of hydrogen, while chlorobenzoic acid has only five atoms; and in the place of the missing hydrogen atom an atom of chlorine. Let us take another illustration. I am here acting upon acetic acid by alcohol, and I get in that receiver a body termed acetic ether. Now the difference between acetic acid and acetic ether is of a somewhat different nature to that subsisting between the other normal and derived bodies. Acetic acid has lost an atom of hydrogen and gained a compound substance called ethyl in its place. $C_2H_4O_2$ has become $\cdot C_2H_3EtO_2$. I may give you another mode of substitution. In the bottom of this jar is a small quantity of a substance, a species of kreasote, known by the name of phenic acid, C_6H_6O. Now when I act upon this body with a little strong nitric acid, I obtain a very energetic reaction, which results in the formation of trinitrophenic acid, $C_6H_3(NO_2)_3O$. The action was rather more violent than I expected, although I anticipated that the two bodies would react somewhat violently. The compound that we acted upon is phenic acid, and the compound that resulted is trinitrophenic acid, differing from the original body in this particular, that in it we have three atoms of hydrogen less, and in the place of those three atoms of hydrogen we have acquired three atoms of a compound of nitrogen and oxygen, known by the name of pernitric oxide.

I might refer to many other varieties of substitution, but the only substitution products I shall have occasion to refer to in illustration of my series of mineral acids are those which I have just exemplified to you, namely, metal-substitutions, chlorine-substitutions, ether-substitutions, and nitro-substitutions. The great service of those substitution compounds to us is this: — I want to explain to you the nature of series, and there are scarcely any two series complete, but the gaps which exist in them can be filled up by analogous substitution compounds. In several cases where I cannot put the acid into my series, I shall put the metallic representative, or the chloro representative, or the ethyl representative of that acid.

Now then for our series. The first member to which I will direct your attention is this,—muriatic acid or chlorhydric acid. In the first place this body has an extremely simple constitution; in the next place, all the world is agreed as to what its constitution is. It consists of one atom of hydrogen, and one atom of chlorine. This white block represents the bulk of one grain of hydrogen, and this green block represents an equal bulk of chlorine; that is a quantity of chlorine which weighs 36 grains, so that the two elements unite in proportion of atom to atom, bulk to bulk, 1 grain to 36 grains. Muriatic acid ordinarily exists as a gas. We have here a tube full of it. If I allow water to gain access to the gas, so extreme is the affinity of the one for the other that the water will gradually rise in the tube and absorb all the gas. There, it has risen nearly to the top already, and the solution thus formed is ordinarily known as liquid muriatic acid, which is a solution of muriatic acid gas in water. Now, in this limb of the U tube is a certain quantity of muriatic acid gas, and if I act upon it by some readily oxidisable metal heated to redness, the metal takes away the chlorine and leaves the hydrogen. We shall make this iron wire red-hot by means of the galvanic current, and then you will observe the change that takes place. There: now I am going to pour mercury into this limb to bring it to the original position of the experiment, that is to say, that the mercury in the two limbs shall be at the same level. Now, the mercury originally was down to here. We had that quantity of gas; you observe the quantity of gas has diminished to this point. I fear it may not be very visible at a distance. On cooling this residual gas, the decrease will be still more marked, and in the course of a short time, as soon as this space gets thoroughly cool, you will find that one half of the original bulk of the gas has disappeared — that one half being chlorine, the remaining half being hydrogen. This is a very important point to bear in mind. Chlorhydric gas has this characteristic property—it is capable of yielding up one half of its volume of hydrogen; two volumes of chlorhydric acid yield one volume of hydrogen, and this property pertains to fluorhydric acid, bromhydric acid, and to iodhydric acid. Two volumes of any of these gases are capable of yielding one volume of hydrogen, and this property pertains to no other body with which chemists are acquainted, and is therefore a strong reason for associating the four bodies one with the other.

HF Fluorhydric acid.
HCl Chlorhydric acid.
HBr Bromhydric acid.
HI Iodhydric acid.

Now, if we take chlorhydric acid and oxidise it, one of two things may happen. We may oxidise the hydrogen into water and leave the chlorine, or, if we use sufficient oxygen, we may, by operating in a particular manner, oxidise both elements together—thus, we write muriatic acid HCl, and if we take an insufficient quantity of oxygen, that is, if we take only one atom of oxygen to two of muriatic acid, we get the reaction $Cl_2H_2 + O = Cl_2 + H_2O$; that is, if we take an insufficient quantity of oxygen we get the hydrogen oxidated into water and the chlorine set free; but if we take a sufficient quantity of oxygen we get the reaction $ClH + O = ClHO$, the chlorine and hydrogen being oxidated conjointly into hypochlorous acid. Here is the experiment being performed: we have in this U tube muriatic acid HCl, through it we force a current of air, the air takes up the vapour of the acid and passes with it through this retort, containing a powerful oxidising agent, namely, permanganic acid or, what comes to the same thing, a mixture of sulphuric acid and permanganate of potassium. The result is a new oxidised product, or oxide of chlorhydric acid, known by the name of hypochlorous acid HClO. Now this body has not been satisfactorily isolated; it is known only by its solution and by its salts; but its composition has nevertheless been accurately determined. It consists of one atomic volume of hydrogen, one atomic volume of chlorine, and one atomic volume of oxygen, 1 grain of hydrogen, 36 grains of chlorine, and 16 grains of oxygen. Hypochlorous acid is a very interesting body: it is a very powerful bleaching agent.

We have here a solution of it. You see its bleaching action is very rapid; in the course of a few minutes the pattern of the print will have entirely disappeared. Hypochlorous acid HClO, is formed from chlorhydric acid HCl, by the addition of oxygen, and conversely chlorhydric acid is formed from hypochlorous acid, by the abstraction of oxygen. Hypochlorous acid, when boiled, undergoes a very curious change: it becomes chloric acid, $HClO_3$. We have a somewhat complex decomposition, from which this new body, chloric acid $HClO_3$, results. Now, when this chloric acid, which we have here, is deoxidated by means of nitrous acid, it is converted into chlorous acid, $HClO_2$, and when oxidated at the positive pole of a voltaic battery it becomes perchloric acid, $HClO_4$.

HCl	Chlorhydric acid.
HClO	Hypochlorous acid.
$HClO_2$	Chlorous acid.
$HClO_3$	Chloric acid.
and $HClO_4$	Perchloric acid.

Here, then, as shown in the table, we have a series of acids all expressed in the simplest possible formulæ, and arranged in a series, the successive members of which differ from one another in composition by an increment of one atom of oxygen. They are all convertible into one another by mutual metamorphosis; and, although separated widely in every chemical treatise that has been hitherto written, constitute a natural series of chemically associated bodies. Perchloric acid, the last member of the series, has a very curious action upon organic bodies, which I am able to show you. I have here some perchloric acid and aniline; and when the two bodies are heated together for a little time they undergo a very striking decomposition. The action will be indicated in the beginning by a little crackling, then by the production of a flame in the interior of the tube, and a sudden explosion.

We must now pass on to the next body on our list, sulphydric acid, which is a gas like chlorhydric acid. If we act upon it by red-hot iron we take away the sulphur and leave the hydrogen; and that we will now do. We will make the wire red-hot in this U tube containing the sulphydric acid; but mark the difference; in this case there is no alteration of bulk; there is an alteration of bulk depending upon the increase of temperature; but as soon as that increase of temperature has subsided, you will notice no alteration whatever in the bulk of gas. We have here a class of bodies, two volumes of each of which yield only one volume of hydrogen, namely, HF, HCl, HBr, and HI, as we have already observed. We have here another class of bodies, two volumes of each of which yield two volumes of hydrogen:

H_2O	Water.
H_2S	Sulphydric acid.
H_2Se	Selenhydric acid.
H_2T	Tellurhydric acid.

A given volume of any one of these last gases or vapours contains exactly twice the quantity of hydrogen that the same volume of any of the first class of gases contains; and we express this difference in their symbolic formulæ which we write with two atoms of hydrogen. I might illustrate to you the propriety of assigning this bihydric formula to water, by means of the well known experiment of the electrolytic decomposition of water, in which two volumes of hydrogen gas are produced for every one volume of oxygen; but you have seen it so often, and my time is expiring so quickly, that I think I had better go on telling my story. Let me now direct your attention to the oxygen compounds of sulphydric acid, as shown in the table:

H_2S	Sulphydric acid	Cl_2S
H_2SO	wanting	Cl_2SO
H_2SO_2	wanting	Cl_2SO_2
H_2SO_3	Sulphurous acid	
H_2SO_4	Sulphuric acid	

In this series we have two gaps, which, however, we can fill up by the chlorine representatives of the missing bodies Cl_2SO, and Cl_2SO_2 respectively, which are obtainable from Cl_2S by successive oxidation. The first product actually afforded by the oxidation of sulphydric acid is sulphurous acid. Thus, if we burn sulphuretted hydrogen in air or oxygen we obtain sulphurous acid. You observe the gas burns in this globe of oxygen with great brilliancy, and we have in the globe the product of its oxidation or combustion, namely, sulphurous acid, the presence of which is manifested to you by the deep blue colour produced on the addition of a solution of starch and iodic acid. Hence, if we add oxygen to sulphydric acid H_2S, we get sulphurous acid, H_2SO_3, and conversely, if we take away oxygen from sulphurous acid, by means of nascent hydrogen, for instance, we reobtain sulphydric acid. By a further oxidation the sulphurous acid H_2SO_3 becomes sulphuric acid H_2SO_4. Mere exposure to air is sufficient to effect the change, or we may use more powerful oxygenants. I can show you this conversion in a very simple manner. We have here a solution of sulphurous acid, and if we add to it a little chloride of barium we get no precipitate, because the sulphite of barium is moderately soluble in water. But if we now add some chlorine water we oxidate the sulphurous acid into sulphuric acid, and at once get a precipitate of sulphate of barium. Conversely, by deoxidising sulphuric acid we get sulphurous acid, as in the ordinary process for preparing sulphurous acid. Including our chlorine representatives of the two missing bodies, we have here a second series of acids, associated with one another by a common increment of composition and by mutual metamorphosis. Sulphuric acid H_2SO_4 is the representative on the sulphur series of perchloric acid $HClO_4$ on the chlorine series. Each contains one atom of the radicle which gives the special character to the acid, in the one case chlorine, in the other sulphur. Each contains also four atoms or volumes of oxygen; but whereas perchloric acid contains only one atom or volume of hydrogen, sulphuric acid contains two atoms or two volumes. And this difference in composition leads to a marked difference in the properties of the two acids. Perchloric acid $HClO_4$ has only one atom of hydrogen that can be replaced. Hence we have only one salt, such, for instance, as perchlorate of potassium, $KClO_4$, and only one ether, such, for instance, as perchloric ether $EtClO_4$. But sulphuric acid has two hydrogen atoms that can be replaced. Hence we have acid salts, neutral salts, double salts, acid ethers, neutral ethers, double ethers, and saline ethers, as shewn in the table.

H_2SO_4	Sulphuric acid.
$KHSO_4$	Acid sulphate of potassium.
K_2SO_4	Neutral sulphate of potassium.
$KNiSO_4$	Potassio-sulphate of nickel.
$EtHSO_4$	Ethylo-sulphuric acid.
Et_2SO_4	Neutral sulphate of ethyl.
$EtMeSO_4$	Ethylo-sulphate of methyl.
$EtKSO_4$	Ethylo-sulphate of potassium.

Now this property of forming acid and double salts, and acid and double ethers, &c. indicates a fundamental difference in character between sulphuric and perchloric acids, a difference that is satisfactorily represented by the difference in their formulæ as here written down, $HClO_4$, and H_2SO_4, a difference, however, which is not indicated in any English treatise on chemistry. The same bibasic character is manifested as decidedly by the sulphurous and sulphydric acids.

Now we will proceed with another gas, namely, phosphamine, which is a body also containing hydrogen, and if we make an iron wire red-hot in this gas we take away the phosphorus and leave the hydrogen. In this case the two volumes of phosphamine will give three volumes of hydrogen, or the quantity of gas will actually increase. The iron wire has taken up the phosphorus and the gas has expanded. We will bring the mercury to the same level in the two limbs of the tube and then you will perceive the actual expansion. In this case the two volumes of gas have increased to three. Two volumes of chlorhydric gas yield one volume of hydrogen; two volumes of sulphydric gas yield two volumes of hydrogen; and two volumes of phos-

phamine yield three volumes of hydrogen, and this is a most important distinction between the three classes of hydrides to which these three gases respectively belong.

Two volumes of each of the twelve gases shown in the table yield as many volumes of hydrogen as are indicated in their respective formulæ.

HF	Fluorhydric.	H_2O	Water.	H_3N	Ammonia.
HCl	Chlorhydric.	H_2S	Sulphydric.	H_3P	Phosphamine.
HBr	Bromhydric.	H_2Se	Selenhydric.	H_3As	Arsenamine.
HI	Iodhydric.	H_2T	Tellurhydric.	H_3Sb	Stibamine.

I may illustrate to you the constitution of this third class of hydrides by means of ammonia, which stands first on the list. I can show you the decomposition of ammonia in a different manner, by means of an instrument for which I am indebted to the kindness of Dr. Hofmann. I have in this U tube a quantity of ammoniacal gas, through which we are going to pass a succession of electric sparks. You will notice the small sparks taking place at the upper part of the tube. Now that small spark is decomposing the ammoniacal gas, and you see the bulk of gas is sensibly increasing. While the experiment is going on, we will proceed with our series of oxides of phosphamine.

H_3P	Phosphamine	Cl_3P	Et_3P.
H_3PO	wanting	Cl_3PO	Et_3PO.
H_3PO_2	Hypophosphorous acid.		
H_3PO_3	Phosphorous acid.		
H_3PO_4	Phosphoric acid.		

At starting we meet with a gap. In the first series there are no gaps, in the second series there are two gaps, and in the last series there is one gap, but in this case we have the chlorine representative of the missing body, and Mr. Brodie has ascertained that by directly oxidating this body, Cl_3P, he gets that body Cl_3PO. Or I may draw your attention to another representative of this missing compound, namely, the oxide of triethyl-phosphine. The liquid I have in my hand, which was discovered by Dr. Hofmann, through whose kindness I am enabled to show it you, is triethyl-phosphine, Et_3P, or phosphamine in which the three atoms of hydrogen are replaced by ethyl; and when this body is acted upon by oxygen it becomes converted into the ethyl representative of our missing body. I will here show you the experiment. I am about to fill this tube with oxygen; now into this tube of oxygen we are going to put a little triethyl-phosphine. On warming the two bodies a combination will take place, and we shall have produced the compound Et_3PO, that is the ethyl representative of our missing phosphorous body [explosion]. That noise was consequent upon the union of the oxygen in the tube with this ethyl representative of phosphuretted hydrogen or phosphamine.

Now I think our decomposition of ammonia by the Ruhmkorff spark has gone on to a sufficient extent. We will just reduce the mercury in the two limbs to the same level by letting out some of the mercury in this limb, and I think you will be able to see the expansion which the ammoniacal gas has undergone. You see the two volumes contained in the tube have become very nearly four volumes, and would have become quite four volumes if we had allowed the action to have gone on a little longer. All our compound gases occupy two volumes. Hence when we abstract the phosphorus from two volumes of phosphamine H_3P, we get three volumes of hydrogen left. When we decompose two volumes of ammonia H_3N by the electric spark, we convert them into three volumes of hydrogen and one volume of nitrogen, making altogether four volumes.

We now come to the first actual oxide of phosphamine, namely, hypophosphorous acid. This acid is not familiarly known to chemists, and its modes of formation have not been much studied. I do not know that it has ever been obtained by oxidating phosphamine, but I know the reverse instance, that you do get phosphamine by deoxidating hypophosphorous acid. I cannot say whether this body H_3PO_2, has been obtained from that H_3P, by adding oxygen to it, but I know that this body H_3P, is obtained from that H_3PO_2, by taking oxygen from it. When we act upon hypophosphorous acid, with nascent hydrogen, or when we heat the acid or any one of its salts we get phosphuretted hydrogen produced. We have here some of the hypophosphite of lime which is a salt a good deal used in medicine; when we heat this substance, it gives off phosphuretted hydrogen, which takes fire, as you perceive, and this is the only mineral salt I think I may say which is inflammable. It is a saline substance, looking like common salt, and the moment you heat it, it gives off phosphuretted hydrogen, and hence the mass burns very much in the same manner that phosphorus does. This brings me to the end of my hour, but not to anything like the end of what I intended to say, and you will perhaps kindly afford me a few minutes more to bring my subject to a conclusion. We have just said that hypophosphorous acid, by deoxidation, forms phosphuretted hydrogen; now by oxidation, it forms successively phosphorous and phosphoric acids, the two next bodies on our list. Phosphorous acid H_3PO_3 may be produced by the direct oxidation of phosphuretted hydrogen. Thus a mixture of phosphuretted hydrogen and oxygen, standing over water, is gradually absorbed with formation of phosphorous acid. Conversely, when phosphorous acid is acted upon by nascent hydrogen, its oxygen is abstracted, and it is reconverted into phosphuretted hydrogen. Phosphoric acid H_3PO_4 is producible by the oxidation of phosphuretted hydrogen, of hypo-phosphorous acid, and of phosphorous acid. It is a very stable substance, but nevertheless we are capable of taking away its oxygen and thereby liberating phosphuretted hydrogen, as is the case, for instance, when we act upon it by metallic sodium. Here again then we have a series of naturally associated and mutually convertible bodies, represented by the simplest possible formulæ, by formulæ which do not express any speculative view whatever, but merely indicate the indisputable fact that these bodies, or their representatives, differ from one another in composition, by the successive increments of one, two, three, and four oxygen atoms. Phosphoric acid, H_3PO_4, is the representative on the phosphorus series, of sulphuric acid H_2SO_4, on the sulphur series, and of perchloric acid $HClO_4$, on the chlorine series; but whereas perchloric acid contains only one atom of hydrogen and can form only one class of salts and ethers; whereas sulphuric acid contains two atoms of hydrogen and can form only two classes of salts and ethers; phosphoric acid contains three atoms of hydrogen, and can form three classes of salts and ethers. One-third, two-thirds, or three-thirds of its hydrogen may be displaced by a metal or basic radicle, or the hydrogen may be partly or wholly displaced by two or three different metals, or by two or three different radicles, or by a mixture of metals and radicles, thus: $EtKCuPO_4$, or $H.NH_4NaPO_4$, &c.

We must now pass on to another primary hydride, namely, that of silicon, the siliciuretted hydrogen of Wöhler. The composition of this body has not been ascertained. It has been ascertained, however, that the substance from which it is obtained by the action of chlorhydric acid, is a silicide of magnesium, represented by the formula Mg_4Si, whence we infer the formula of siliciuretted hydrogen to be H_4Si, analogous to that of marsh gas H_4C, a conclusion strongly confirmed by the composition of chloride of silicon, which has been demonstrated to be Cl_4Si, that is, a chloro-representative of siliciuretted hydrogen. Each of our other primary hydrides has yielded us a remarkably stable acid, formed by the addition of four atoms of oxygen to the hydride; and our hydride of silicon ought to behave in the same manner, thus:

Chlorhydric acid	H Cl	$HClO_4$	Perchloric acid.
Sulphydric acid	H_2S	H_2SO_4	Sulphuric acid.
Phosphamine	H_3P	H_3PO_4	Phosphoric acid.
Hydride of Silicon	H_4Si	H_4SiO_4	Silicic acid.

Now whether or not H_4SiO_4 is the correct formula for silicic acid, it is quite certain that the great majority of

simple and well-defined silicates may be referred to that type, as illustrated in the table.

Orthosilicates.

Et_4SiO_4	Silicic ether.	Gl_4SiO_4	Phenakite.
Li_4SiO_4	Silicate of lithium.	Ce_4SiO_4	Cerite.
$Na_2H_2SiO_4$	Silicate of sodium.	Fe_4SiO_4	Fayelite.
Ca_4SiO_4	Silicate of calcium.	$Fe_3Mn_2SiO_4$	Knebelite.
Mg_4SiO_4	Olivine, Chrysolite.	$Cu_2H_2SiO_4$	Dioptase.
$Ca_3Mg_2SiO_4$	Batrachite.	Al_2CaSiO_4	Anorthite.
Zn_4SiO_4	Zinc glance.	Al_2MnSiO_4	Karpholite.

This next table illustrates to you the general relations of the perchloric salts and ethers, to their sulphuric, phosphoric, and silicic analogues. The existence of the silicated compounds corresponding to the formulæ in italics, has not yet been established.

Acids, Salts, and Ethers.

H Cl	$H ClO_4$	$\begin{cases} Na\ ClO_4 \\ Et\ ClO_4 \end{cases}$		
H_2S	$H_2S\ O_4$	$\begin{cases} Na_2S\ O_4 \\ Et_2S\ O_4 \end{cases}$	$Na\ H\ S\ O_4$ $Et\ H\ S\ O_4$	
H_3P	$H_3P\ O_4$	$\begin{cases} Na_3P\ O_4 \\ Et_3P\ O_4 \end{cases}$	$Na_2H\ P\ O_4$ $Et_2H\ P\ O_4$	$NaH_2P\ O_4$ $Et\ H_2P\ O_4$
H_4Si	H_4SiO_4	$\begin{cases} Na_4Si\ O_4 \\ Et_4Si\ O_4 \end{cases}$	$Na_2H\ Si\ O_4$ $Et_2H\ Si\ O_4$	$Na_2H_2SiO_4$ $Et_2H_2SiO_4$ | NaH_3SiO_4 EtH_3SiO_4

Considering the relations of ammonia and phosphuretted hydrogen, H_3N and H_3P respectively, and the relations of marsh gas, and siliciuretted hydrogen, H_4C and H_4Si respectively, we should expect to have nitrates and carbonates having the general formulæ M_3NO_4, and M_4CO_4 respectively, corresponding to ordinary phosphates and silicates having the general formulæ M_3PO_4 and $M_4Si\ O_4$ respectively. It is observable, however, that in addition to our ordinary phosphates and silicates, we have other phosphates and silicates, known respectively as metaphosphates and metasilicates, which differ from the ordinary salts and the loss of an atom of base, and that it is these metasalts to which our ordinary nitrates and carbonates correspond, thus:—

Phosphate	$M_3PO_4 - M_2O = MPO_3$		Metaphosphate.
		MNO_5	Nitrate.
Silicate	$M_4SiO_4 - M_2O = M_2SiO_5$		Metasilicate
		M_2CO_3	Carbonate.

We are acquainted, however, with a considerable number of carbonates and nitrates, which we may call orthocarbonates and orthonitrates respectively, that do correspond in their formulæ with our ordinary silicates and phosphates, as shown in the table.

Orthocarbonates.

Ca_4CO_4	Dicarbonate of calcium
Zn_4CO_4	Dicarbonate of zinc
Mg_3HCO_4	Dicarbonate of magnesium
Pb_4CO_4	Dicarbonate of lead
Pb_3HCO_4	White lead
Cu_4CO_4	Mysorine
Cu_3HCO_4	Azurite
$Bi'''HCO_4$	Dicarbonate of bismuth

Orthonitrates.

Pb_2HNO_4, $Pb_3\ NO_4$	of lead
$Hg_3\ NO_4$, Hg_2HNO_4	of mercury
$Bi'''NO_4$	of bismuth

The succeeding tables present you with lists of the principal ter-oxy and tetra-oxy mineral acids.

Ter. Ox. Acids.		*Tetra Ox. Acid.*	
Chloric	$H\ Cl\ O_3$	Perchloric	$H\ Cl\ O_4$
Bromic	$H\ BrO_3$	Periodic	$H\ I\ O_4$
Iodic	$H\ I\ O_3$	Permanganic	$H\ Mn_2O_4$
Nitric	$H\ N\ O_3$	Sulphuric	$H_2S\ O_4$
Metaphosphoric	$H\ P\ O_3$	Selenic	$H_2Se\ O_4$
Sulphurous	$H_2S\ O_3$	Telluric	$H_2T\ O_4$
Selenious	H_2SeO_3	Oxalic	$H_2C_2\ O_4$
Tellurous	$H_2T\ O_3$	Molybdic	$H_2Mo_2O_4$
Carbonic	$H_2C\ O_3$	Vanadic	$H_2V_2\ O_4$
Metasilicic	H_2SiO_3	Tungstic	$H_2W_2\ O_4$
Titanic	$H_2Ti\ O_3$	Chromic	$H_2Cr_2\ O_4$
Stannic	$H_2Sn\ O_3$	Manganic	$H_2Mn_2O_4$
Vanadous	$H_2V_2\ O_3$	Ferric	$H_2Fe_2\ O_4$
Phosphorous	$H_3P\ O_3$	Orthonitric	$H_3N\ O_4$
Arsenious	$H_3As\ O_3$	Phosphoric	$H_3P\ O_4$
Antimonous	$H_3Sb\ O_3$	Arsenic	$H_3As\ O_4$
Bismithous	$H_3Bi\ O_3$	Antimonic	$H_3Sb\ O_4$
Boracic	$H_3B\ O_3$	Orthocarbonic	$H_4C\ O_4$
Aluminous	$H_3Al_2O_3$	Silicic	$H_4Si\ O_4$

Hence it seems we may take as our general type for an acid the formula $H_xR_yO_z$, where H_x represents the atoms of hydrogen, which, save in carbon compounds, are found to vary only from 1 to 4; where R_y represents the acid radicle, that is the chlorine, or sulphur, or phosphorus, or carbon, &c. which gives the special character to the acid, and which, save in carbon compounds, is usually confined to 1 or 2 elementary atoms; and where O_z represents the atoms of oxygen which generally range from 0 to 4, but occasionally extend to higher numbers.

I did intend to make a few remarks on the hydration of salts, but time will not allow me. I will, however, direct your attention to a remarkable experiment which I am able to show you through the kindness of Mr. Hadow of King's College. This bright red sheet of paper owes its colour to a deposit upon its surface of the hydrated platino-cyanide of magnesium. Now when we heat this paper over a lamp, the red platino-cyanide loses water and becomes pale yellow, or nearly colourless, as you perceive. If we now moisten the portion of the paper bleached by the heat, we restore the red colour, but if we moisten the unheated portion of the paper which is still red, we cause the redness to disappear. The solution of platino-cyanide of magnesium is colourless, hence the bleaching effected by water; the ordinary hydrated salt is red; and the less hydrated salt is pale yellow, hence the bleaching effected by heat, and the restoration of the red subsequently effected by moisture. It now only remains for me to say, in conclusion, that if chemists will be content to associate bodies without any speculative views of their constitution, by means of unitary formulæ arranged in series, they will gain one of the most easy methods of correlating different bodies, a method which is true because it involves nothing but the fact of their relation of composition, and their relation of properties, exemplified in the case of the acids by mutual metamorphosis. On the first occasion on which I had the honour of addressing this audience, I caused some merriment by criticising the formulæ of others. It was then suggested to me that instead of criticising bad formulæ I should introduce better ones. Those then are my seriated substitution-formulæ, which if they do not express the whole truth at any rate express no falsehood.

SOCIETY OF ARTS, *Wednesday, 28 March* 1860.

THOMSON HANKEY, *Esq., M.P. in the Chair.*

THE paper read at this meeting of the Society of Arts, by Mr. ROBERT BARCLAY, was devoted to the consideration of various means for the *Prevention of Forgery arising from the Alteration and Falsification of Cheques, Notes, &c.* The lecturer first pointed out the liability to fade to which ordinary writing ink is subject, and the great difficulty of obtaining a carbon-ink of the necessary consistence and which cannot be washed from the surface of the paper. An ink composed of sugar, indigo, and dilute sulphuric acid may give very permanent characters, but a hot iron must be passed over the writing to effect the carbonisation of the sugar, and the acid thus concentrated may exhibit its destructive powers in an unpleasant manner upon the substance of the paper itself. Mr. Barclay then turned to the question of the fraudulent alteration of commercial documents, &c. by chemical means, and of the importance of preventing this with the aid of the same science. "I therefore propose to consider," he said, "in the first place, the various expedients which have been proposed and carried out into practice for the prevention

of this description of forgery, several instances of which have occurred (one as lately as the spring of 1859, at one of the branches of the Bank of England), in which both the crossing was obliterated and the amount altered. This is a danger already in a measure provided against by the public, and I shall endeavour to show that the expedients hitherto adopted with this view are imperfect, and that a complete scientific defence against the skilful chemical abstraction of writing is required and provided by the chemically prepared white writing paper which I am desirous to introduce to the notice of your Society and the public.

"In the second place, I shall show that, by the incorporation of similar chemical substances in ordinary writing papers, we may so remove the fading tendency of common writing ink as to render it permanent to a great age. I shall also describe a method of rendering printed characters unalterable by any process whatever, and effectually preventing the mechanical erasure of writing. Before describing the remedies which have been proposed by others, it may be well to exhibit the wide range of substances which more or less perfectly obliterate writing ink, under the three following heads:—

Bleaching Agents.	Acids and Acidulous Salts.	Alkalies.
Chlorinated carbonate soda	Binoxalate-potass	Potash
Solution of bromine	Hydrochloric acid	Soda
Ditto chloride of ditto	Nitro muriatic acid	
Chloride of lime	Oxalic acid	
Bromide of lime	Citric and tartaric acid	
Solution of chlorine	Sulphurous and	
Chromic acid	Sulphuric acid	
Oxygenated water		

"I have often remarked that, even amongst persons possessing some knowledge of chemistry, an impression prevails that acids are the most ready and powerful dischargers of ink. The fact, however, is, that bleaching liquids are vastly more effective, and their action is more elegant and perfect. Hence has resulted the erroneous conclusion that the obliteration or discharge of ink is a hazardous and doubtful process, and that, therefore, any special means of prevention are not imperatively demanded.

"We have here a list of 18 substances of the most diverse chemical properties, and it will be seen that the problem to be solved is one of considerable difficulty, because, if there is a single reagent on the list which will discharge and bleach writing ink, a method possessing, perhaps, the highest excellence in absolutely preventing the discharge of ink with one class of substances, is totally useless if attacked with another of an opposite class."

Various patents, having for their object the production of a paper calculated to render abortive all attempts to obliterate any portion of the writing upon its surface, were then cited. We will briefly glance over the list. The process of Gabriel Tigere, patented in 1817, consisted in impregnating the paper with prussiate of potassa before sizing it, which latter operation was then performed as usual. In 1822, William Robson's method of preventing frauds upon cheques, bills of exchange, &c. was patented; here, vegetable colours, those extracted from saffron and logwood being preferred, were ruled or printed upon the paper in such a way, that upon the application of any acid these colours would be destroyed as well as the ink. The cheque paper now in use may be said to be in some measure based upon this patent, as they are nearly always tinted with various organic colouring matters. W. Stone's patent, in 1851, was for the use of ferrocyanide of potassium, iodide of potassium, and starch, which substances were applied to the paper during the sizing process. Very similar to that of Tigere is the process of W. Herapath, patented in 1858, who however employs, in addition, the ferri- and sulpho-cyanides of potassium. Robson's method is decidedly unsafe, inasmuch as the writing may be readily discharged at any part, and the colour or engraved work may be afterwards retinted wherever necessary. The process of Tigere is, according to Mr. Barclay, based upon sounder principles, as upon attempting to discharge the writing with any acid or acidulous salts, Prussian blue is instantly formed, and the writing is thus made still more apparent. The ferrocyanide constituting the sole security of this paper, may however be quickly dissolved out with water first made slightly alkaline. This paper also offers no protection against bleaching agents.

For a description of his own process, we will take Mr. Barclay's words *verbatim*:—

"The constituent of my patent is the incorporation of an insoluble ferrocyanide and an insoluble salt of manganese with the paper pulp. I have found the insoluble white ferrocyanide of manganese, in a state of purity, the most suitable for my purpose. A special process is adopted for preventing waste and fixing the insoluble powder in the fibre of the paper, and the discoloration during the sizing process is prevented by the use of a mordant of the acetate of alumina, which perfectly fixes the size and prevents its decomposition; the paper is passed through the drying process with rapidity, and in this way the practical difficulties in the incorporation of a ferrocyanide are completely surrounded, and I obtain a pure white paper which effectually obviates the objection to the use of tinted papers, and renders no change whatever in the appearance of paper to which the patent is applied.

"This is a most important practical result, as any peculiarity of appearance involving a change is inconvenient, and is resisted both on valid practical grounds, and also on the simple principle of conservation, still I wish it to be clearly understood that, under my patent, any description or tint of paper can be produced.

"The chemical principle of this paper is perfectly adapted to obviate the dangers arising from the wide range of ink discharging chemical substances.

"By the application of acids the writing ink becomes fixed more firmly in the paper, and is converted into Prussian blue. Mordanted with the alumina contained in the size, chlorine and bromine have a still more powerful effect in causing the writing instantly to penetrate to the back of the paper, and to assume greater intensity than before, and the stains of the peroxide of manganese also appear. Chloride of lime and chlorinated soda, and bromine of lime, produce the intense brown dye of the peroxide of manganese, as calico printers term it, manganese brown; if this is dissolved out it will be found the writing will reappear, being not destroyed but merely obscured.

"Alkalis and their carbonates, and oxygenate water, have a similar effect in producing manganese brown. Chronic acid causes the deposition of the green oxide of chronium in addition to the manganese brown.

"Every chemical substance which discharges the colour of Prussian blue produces manganese brown, and *vice versâ*. The chemist, therefore, is involved in an alternation of effects whichever class of chemicals is applied, and in the present state of our knowledge it is a net from whose meshes the utmost skill will not extricate him. As long as the insoluble material remains in the paper the writing cannot be destroyed. By dissolving out, and destroying the protective material from the substance of the paper, which in itself is a most hazardous operation, we may discharge a portion of the ink, but this involves still greater difficulties, since, when done, it is found to be totally inapplicable, as the stain, alternating according to the chemicals used, drives the operator to the edge of the document, and every portion of it is destroyed. Professor Brande, of the Mint; Dr. Miller, of King's College, and Mr. R. Warington, of Apothecaries' Hall, will bear me out in saying that actual experiment will alone enable any person to appreciate the vast difficulties which present themselves in the effort to discharge a portion of the writing. These, though they employed time, patience, and the resources of their well-known skill and ingenuity, they failed to overcome.

"I have myself most fully followed up, by actual experiment, every idea, for evading the security of the paper,

which has been suggested to me by scientific friends, and though some hundreds of experiments have been made with this view, I have not yet seen a single successful attempt to discharge a portion of writing placed upon this paper, without the production of stains or the destruction of the entire document.

"These stains entirely prevent the possibility of restoring, by artistic skill, the appearance of a cheque or other document printed or written on this paper.

"I produce specimens of the paper containing various amounts of the protective material."

Further on he says:—

"The cheques of the London bankers may be thus classified:—

"1. Tinted cheques which are of imperfect security, and can be evaded without the process of re-tinting.

"2. Tinted cheques exhibiting the perfection of Robson's principle, but which are evaded by bleaching the writing and restoring the tinting.

"3. Cheques on Tigere's patent, evaded by bleaching liquids, and slightly re-tinted.

"4. Cheques on plain paper, which present little difficulty to any and every alteration which the convenience of a forger may require.

"All these checks are, however, open to a variety of manipulations, and I would call attention to the ease with which the writing may be bleached in the lines of the letters or figures, and the most elaborate, and at first sight, inimitable engraving may be re-produced by joining the lines of the engraved ground-work. It is in many cases necessary only to alter a very few letters to increase the amount of a cheque, but a larger portion of these engraved tablets may be reproduced by an artist's hand with certainty, it is merely a question of a little more time and labour.

"Vegetable tinted paper may be re-tinted by a person accustomed to water-colour painting.

"I consider the principle of obliging the forger to discharge in addition to the ink a vegetable colour, imperfect and founded on a false assumption, viz. that a colour which is bleached cannot be re-tinted. The reply to those who urge the difficulty of doing it, is simply that there is no occasion to destroy more than a very small portion of the tinting, and that this is not a question for a chemist but for an artist, and also that any person who is not an artist, if he will take the pains, may prove to himself that it is not a matter requiring much skill.

"The principle of my paper is to oblige the forger permanently to dye a white paper, by an attempt to bleach the ink.

"The difficulty of discharging the smallest portion of writing upon cheques printed on my peper, is precisely as great as if the largest portion is operated upon."

We omit some observations upon the general importance of the subject, but of no special interest, and also a mass of somewhat irrelevant matter intended to evidence the great durability of Prussian blue, *except* when exposed to the action of alkalies, or to that of moisture and sunlight combined. Our author, however, seems not to be aware that this pigment may, by careful manipulation, be dissolved in oxalic acid. We learn from a quotation from Stahl, that Prussian blue was accidentally discovered in 1704, in the following manner:—

"A colour maker, of the name of Diesbach, who was making a cochineal lake called Florentine lake, mixed the decoction of cochineal with alum and a little sulphate of iron. The colour he struck with an alkali, and being once short of it, he was given by Dipple, a chemist, in whose laboratory he was working, salt of tartar, with which this chemist had distilled many times — an animal oil. The lake, which by the usual alkali would have been thrown down a red, became first purple, then blueish, then a most beautiful blue or gentian colour.

"Diesbach was aware of the way in which the salt of tartar had been previously treated.

"Dipple, to whom he communicated the intelligence of this strange appearance, knew at once it must proceed from the peculiarity of this salt of tartar he had given him, and investigated the result, and he was soon able to give this quality in a simple manner to another salt. These researches were attended with happy results, and from this time forward the discovery of Prussian blue was established.

"This blue was first shown in the Exhibition of the Academy of Berlin, in the year 1710, without any description of the proceeding by which it could be manufactured. Many chemists endeavoured to discover the secret.

"In the year 1724, Mr. Woodward, F.R.S., published the process in the *Philosophical Transactions*."

Mr. Barclay claimed the use, not only of the ferrocyanide of manganese, but also the combinations of zinc, lead, tin, and copper, with the radical just indicated. Upon the conclusion of the paper, an animated discussion supervened, of which we can only notice the more prominent points.

Mr. Herapath (of Bristol) thought that as Mr. Barclay had closely criticised other patents, he should have mentioned that of David Stevenson, 1837, No. 7313. This patent was for exactly the same thing as Mr. Barclay's, viz. the use of ferrocyanide of manganese, and had expired in 1851. As Stevenson's process had fallen into disuse, it might fairly be presumed that Mr. Barclay's, which was identical with it, was also valueless.

Mr. H. N. Nissen had come prepared to exhibit to the meeting specimens of Mr. Barclay's paper from which the ink had been completely extracted in two or three minutes, and in most cases without leaving any stain.

Mr. Coe differed with Mr. Barclay on several points, considering that he had considerably overrated the dangers to which notes, cheques, &c. were subject. The experience of the Bank of England relative to altered cheques was so small, that they could hardly remember a case in which a cheque had been tampered with by chemical means, and with Glyn's and the London and Westminster banks it was precisely the same. The Bank of England employed only a plain white cheque, which appeared to give all needful security. The great majority of frauds were effected by forgery, on blank cheques improperly obtained. His own experiments had shown that the writing could be completely obliterated from Mr. Barclay's paper.

Mr. Fox pointed out that in the specimens shown by Mr. Nissen the writing had not been obliterated without making a palpable alteration on the surface of the paper.

Dr. Miller could corroborate all Mr. Barclay's statement: he had never succeeded in extracting the ink so completely as in those specimens exhibited by Mr. Nissen.

Mr. Barclay said that Mr. Herapath had failed to establish the identity of Stevenson's patent and his own. The specimens produced by Mr. Nissen, where the writing had been extracted, would be immediately detected by any bank clerk. The writing itself was not in a firm hand, and the ink had never penetrated the paper. Various proportions of protective material could be introduced into the paper, and Mr. Nissen's specimens had not been strongly prepared.

The Chairman in proposing that the thanks of the Meeting be awarded to Mr. Barclay, said that even those who objected to some of his views must admit that a free discussion like the present must tend to good. At the conclusion of his remarks the vote of thanks was passed, and the Meeting separated.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, 20 March 1860.

Wm. Fairbairn, *Esq., F.R.S. &c. President, in the Chair.*

The President exhibited two large pans of cast iron, procured by Mr. Worthington from China, where they are used for boiling rice. The metal, which was at the strongest part only one-tenth of an inch in thickness, possessed con-

siderable malleability. The President remarked that the art of making such large castings of thin metal was unknown in England.

Some conversation took place respecting the proposed Telegraph to connect Great Britain with America, by using Iceland, Greenland, and Labrador as intermediate stations.

Mr. F. Gisborne, the original projector of the Atlantic Telegraph, said that the fears which had been expressed that the cable would be destroyed on the coast of Labrador by grounded icebergs, were not warranted. He was intimately acquainted with the locality, and although there was an immense number of icebergs which grounded on the coast, some, as he had himself observed, in seventy fathoms water, yet, as at Newfoundland, there were inlets with water in the middle of sufficient depth to secure the cable from injury.

A paper was read by John Graham, Esq. entitled *On the History of Invention as applied to the Dyeing and Printing of Fabrics. Part II. Mechanics.*

Professor Roscoe made a communication to the Society concerning the alleged practice of arsenic eating in Styria. He stated that his object was to settle the long debated question as to the possibility of the human body being able to accustom itself to doses of arsenic, as it is known to be able to do to doses of opium, alcohol, and other substances taken in quantities, which under ordinary circumstances would produce fatal effects. The statement that the peasants of Styria are in the habit of taking doses of arsenic which would to ordinary persons prove fatal, seems to originate with Von Tschudi. Professor Taylor in his work on Poisons, places discredit on Von Tschudi's statements, but gives no positive proof concerning the matter. Dr. Roscoe had obtained much information on the subject direct from Styria, through his friend Professor Von Pebal of Lemberg, and the subject was now mentioned simply to call the attention of the members of the society to the question, and, if possible, to obtain further definite information. Dr. Roscoe did not venture to express any opinion on the subject at present; he hoped before long to receive conclusive evidence from a circular addressed to the medical men of Styria; the results of the inquiry he would communicate on a future occasion. Mr. John Graham remarked that much information on the effects of small and continued doses of arsenic might probably be gained in Manchester, where arsenical preparations were used in so many different manufactures. Dr. Roscoe stated that he should feel much obliged if the members could give him opportunity of examining any case of the action of arsenic upon the human body.

Microscopical Section.—*March 19th*, 1860.

A communication was read from Mr. John Hepworth, of Crofts Bank, accompanying a box of mounted specimens of various kinds of cotton and other fibrous materials.

Mr. Hepworth states that "the average breadth of the cotton cell is about $\frac{1}{500}$th of an inch, except near its attachment, where it gradually tapers to about $\frac{1}{700}$th of an inch.

"The ultimate fibre of which the cell wall is composed is longitudinal, and inclined in a spiral direction round the tube (? this might arise from position); it is rarely seen, and never, Mr. Hepworth thinks, except with polarised light and good definition. The cell wall in most specimens appears homogeneous."

Mr. Dancer presented a bottle of water from his marine aquarium, containing large rotifers and other marine infusoria.

Mr. Brittain exhibited a specimen of a new mode of mounting large objects in Canada Balsam.

Mr. Brothers showed the circulation in an acharis, spawn of snails, infusoria, &c.

Mr. Mosley exhibited some living marine animalculæ from the fosse or inundation at Gibraltar, consisting of gammarus fluviatilis, temora, and others, collected by Mr. Frembly, of that place.

Chemical Society.—The next meeting of this Society will take place on Thursday, 19th April, when the following papers will be read:—*Contributions to the History of Cinnamic Acid*, by Mr. D. Howard; *On Crystallised Potassium*, by Mr. C. E. Long. Our report of the last meeting of this Society is, owing to the length to which Dr. Andrewes' paper *On Ozone* extends, postponed until the next number of the Chemical News.

NOTICES OF PATENTS.

For the Manufacture of a Pulp for Paper-making and other purposes, from the leaves or fruit of the citron, orange, or lemon tree. Frederick Brown. (Provisional protection only.)

The patentee takes the leaves or fruit and steeps them in boiling water for half an hour. The mass is then put in the engine and washed with hot water; then clean lime water is added and the washing proceeded with, and when finished the mass is pulped with weak alkali dissolved in hot water. He then bleaches with chloride of lime.

As long as there are a multitude of substances from which cheap paper can be made, we are at a loss to see the advantage of using even the leaves of the trees alluded to. As for the fruit, we can only say that to turn good oranges, lemons, or citrons into middling or bad paper would probably lead to the punishment such a vile metamorphosis would deserve.

Improvements in treating Poppies to obtain a Product resembling Opium therefrom. William M'Andrew and Charles Wilson Boyd. (This process received provisional protection only.)

The patentees, instead of making incisions in the poppy, gather and dry the plant and make an alcoholic extract. It is this extract which they consider to resemble opium. How far the resemblance goes they do not say, and it is plain that for any substance to replace a drug of such vast importance as opium, its chemical composition and medicinal properties would have to undergo the most searching investigation.

A new Moveable Stopper for Gaseous Liquids. P. A. A. Trouttet of Dijon. (Provisional protection only.)

An ingenious contrivance, capable of being adapted to any bottle. By its use any quantity of a gas-impregnated fluid can be obtained without wasting the remainder. It would require an engraving to enable it to be described clearly.

Improvements in Extracting Oils from Coal and other minerals. Fred. Collier Bakewell. (American communication.)

The literature of the coal oil patents is a formidable subject to "get up." There are endless so-called "improvements," "discoveries," "adaptations," &c. There is, however, a wearying sameness about most of them. The present patent is not wholly free from this censure, for it consists mainly of rotating the retort while the coals are distilling. But, inasmuch as the machinery devised for the purpose appears to be simple and effective, and as the patentee uses a low temperature at the same time that he rotates his retorts, we think it probable that the process may be advantageous in regard to the quality and quantity of the oils yielded. The patentee insists upon the temperature not exceeding 850° F. Now in the ordinary retorts, in order to bring the coals in the centre to 850° it is absolutely necessary to raise the sides to a very much higher temperature than this, consequently there is great loss owing to the amount of gas produced. But by rotating the retorts it will be possible to keep the temperature much lower than would be practicable in any other way, because every part of the charge is brought in succession against the sides. The economy of the process is the question. Will the increase of produce pay for the wear and tear and interest of capital on the machinery?

CORRESPONDENCE.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Colouring Matters obtained with Protochloride of Tin.—M. Scheurer-Kestner has communicated some new facts on the products of the oxidation of protochloride of tin, and the solution of some oxides in the bichloride. The bichloride of tin is prepared by oxidising, by means of nitric acid or chlorate of potash, the protochloride added to an equivalent of hydrochloric acid: but the product obtained is not pure. In oxidising the protochloride of tin by means of nitric acid without the addition of hydrochloric acid, the products obtained vary according to the concentration of the solutions. With very concentrated solutions there is a simple oxidation; but with dilute solutions one or more equivalents of nitric acid are fixed. The liquids obtained with concentrated solutions deposit crystals of the bichloride; the liquid separated from the crystals contains stannic acid in solution in the bichloride. The protoxide of tin is easily dissolved by the bichloride forming protochloride and stannic acid which remains dissolved in the excess of bichloride. By adding to the bichloride an excess of protoxide the liquid is changed to a moist mass. The solution filtered away is found to contain only the protochloride; and the paste left on the filter is composed of stannic acid. By oxidising the protochloride of tin with chromic acid a thick liquid of a beautiful emerald green colour is obtained. With titanic acid M. Jourdain has obtained red liquids.[1]

II. ORGANIC CHEMISTRY.

The Green Colouring Matter of Leaves. — M. Frémy has also studied the constitution and composition of chorophyll,[2] which he supposes to be made up of two colouring matters, a blue and yellow, the first of which he names *phyllocyanine*, and the second *phylloxanthine*. M. Frémy discovered that by the action of some bases the green matter of leaves is changed to a beautiful yellow substance, which is easily dissolved by alcohol. In this solution hydrochloric and some other acids will immediately restore the primitive green colour. To separate the blue and yellow matters, M. Frémy proceeded as follows:—He first placed in a stoppered bottle two parts of ether and one part of hydrochloric acid, diluted with a little water, and then shook the bottle strongly for some time. He then submitted to the action of this liquid the body produced by the decolorisation of the chlorophyll, shaking them together for some seconds. The effect was very remarkable. The ether dissolved the yellow matter of the leaves, and became of a beautiful yellow colour, while the hydrochloric acid reacted upon the green matter which had been decolorised, and produced a magnificent blue. The two colours are thus isolated, and, being retained by two different liquids, cannot be mixed to reproduce the green; but if the liquids are separated, and the colouring matters withdrawn from them, solution in alcohol, which dissolves both, gives immediately a green tint, comparable to that of the original chlorophyll. M. Frémy entertains some reasonable doubts whether his phyllocyanine and phylloxanthine really exist in vegetables, and proposes to continue and extend his investigations on the subject. The whole paper is very interesting, and deserves a longer notice than we can give in this correspondence.

Vegetable Colouring Matters.—M. Filhol has been engaged in the examination of vegetable colouring matters, and has discovered some facts which he now publishes as briefly as possible[3], intending to give all the details in a longer memoir. There exists in nearly all flowers, says M. Filhol, a substance which is scarcely coloured when in solution in acid liquids, but which becomes of a beautiful yellow colour when acted on by alkalies. This substance has the following properties. It is solid and of a slightly greenish-yellow colour. It is uncrystallisable, soluble in water, alcohol and ether, and not volatile. When moistened with strong hydrochloric acid it takes a bright yellow tint which immediately disappears when the mixture is diluted with water, leaving an almost colourless solution to which alkalies communicate a yellow colour. The matter is found in the green parts of plants as well as the flowers, and is no doubt the yellow dye found in the leaves of various plants. M. Filhol adopts the name given to it by Hope, and calls it *Xanthogene*. Mosses, he says, do not contain it, or at most, only a trace. It is also absent from some flowers, among others the *Pelargonium Zonale*, and *inquinans Papaver rheas*, Camellias and Salvias. These flowers under the influence of alkalies become blue or violet without the least mixture of green. The colouring matter of these flowers is much less alterable under the influence of air and alkalies than that of most other flowers.

Chemists who have examined yellow flowers, have proved that they owe their colour to several immediate principles; among others, *xanthine* and *xantheine*. The author has discovered *xanthine* in fruits as well as flowers.

III. TECHNICAL CHEMISTRY.

Chrome Green.—M. Casoria[4] gives the following process as the best and cheapest for obtaining chrome green of the first quality:—Mix one part of red chromate of potash with three of boracic acid, and reduce them to fine powder. Fuse the powder in a platinum capsule at a temperature a little below redness, and keep it in a state of fusion until the capsule appears lined with a beautiful green. Then remove the capsule from the fire and immerse it in a quantity of boiling water, stirring up the mass with a small stick. Throw on a filter the substance which is precipitated after the first washing, and continue to wash until the water runs away colourless. An emerald green precipitate of the greatest beauty will be left, which may be dried and pulverised.

[4] *Cosmos*, v. xvi.

MISCELLANEOUS.

New sort of Gun Cotton.—Recently prepared gun cotton soaked for a quarter of an hour in a saturated solution of chlorate of potash, and then pressed and carefully dried is said to have as strong an explosive power as fulminating silver.—*American Journal of Pharmacy.*

The Adulteration of Food Bill has passed the Lower House, and is now in consideration in the Lords. We must defer some remarks on the subject of the bill until our next number.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

W. G. — If our correspondent will repeat his queries they shall be attended to.

E. E. W. — Hopkin and Williams, manufacturing chemists, 5 New Cavendish Street.

Jas. Brown.—Will be answered in a future number.

J. M.—Consult a surgeon. We cannot under any circumstances give advice.

Jean Oyston.—Ultramarine blues are of two kinds, one in which the colouring matter is cobalt, and the other the artificial ultramarine which, according to Brunner, is prepared by repeatedly igniting a mixture of sulphuret of sodium and porcelain clay with fresh quantities of sulphur until the desired tint is produced.

Index.—We will look for the information this correspondent wants.

Chemicus is referred to Dr. Odling's Lecture for the explanation he seeks.

G. E. F.—The ignition was not carried sufficiently far.

[1] *Cosmos*, v. xvi. p. 292.
[2] *Comptes-Rendus*, t. l. p. 505.
[3] *Ibid*, p. 545.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publisher, at the Office, 12 and 13 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

Vol. I. No. 20. — April 21, 1860.

THE ADULTERATION OF FOOD BILL.

In a recent number we gave an analysis of the bill introduced into the House of Commons by Mr. Scholefield and others for preventing the adulteration of articles of food or drink. In the course of its passage through the House some amendments have been introduced, and its action has been extended to Scotland and Ireland; but these amendments do not materially alter it. The great objection to the bill which we pointed out still exists, that is to say, the vendor of the adulterated article must be proved to have a knowledge of the adulteration: now a moment's thought must convince any body of the difficulty, nay, the impossibility even, in some cases of proving a guilty knowledge of this fact. Then, again, the bill permits the vendor to adulterate his goods to any extent with substances not injurious to health, provided he is careful not to warrant them genuine: thus he may add potato starch to his Bermuda arrowroot, and sell it at the price of genuine Bermuda without risk of prosecution so long as he does not insist on its genuineness, if a question whether it be so should happen to be put to him. The first consequence of the bill will therefore be to make this evasion of a positive affirmation of the purity of an article universal among tradesmen. It seems evident, in fact, that adulterations may be carried on within certain limits with perfect impunity: our tea may still contain leaves which have previously done duty; our pepper may contain flour; our milk, water; our beer, salt and treacle; and our butter, water, lard, and flour. All these and similar adulterations, be it remembered, being allowed provided the vendor does not warrant the articles he sells as being pure. Then with regard to other adulterations, such as alum in bread, and sulphuric acid in gin and vinegar, there would be no difficulty in finding chemists who would conscientiously declare that such admixtures were not injurious to health, so that magistrates would be placed in the difficult position of having to decide between scientific opinions diametrically opposed to each other, and whatever decision was given it would in all probability be appealed against.

We believe, therefore, that the bill as it stands will be found wholly ineffectual in checking the practice of adulteration. We can hardly conceive the possibility of a conviction taking place under it if the prosecutor is bound to prove both a guilty knowledge of the adulteration and that the adulterating matters are injurious to health. Nor do we see the necessity for his doing so; the tradesman who sells an adulterated article should be considered as a cheat and punished accordingly.

It is possible that cases might arise in which a slight fine would be adequate to the offence; but cases of this kind might safely be left to the discrimination of the justices; and most certainly we would not admit as an extenuating circumstance that the adulteration was made by the wholesale dealer. The provision we would suggest for a case where the tradesman had been the victim of the wholesale dealer would be to give the former the power of recovering the fine levied upon him from the real offender in the County Court. The fear of exposure would be infinitely greater in the case of the latter than in the case of the retailer, because his customers are fewer in number, and a conviction would in all probability cause him to lose a considerable portion of them.

The power of appeal will probably be retained, but this is likely to prove some obstacle to the effectual working of an Act the enforcement of which is left to individuals. A man may be willing to undergo some trouble and expense from philanthropic motives, if he can see a limit to his expenditure of time and trouble, but he will hesitate to embark in an affair which may not be settled for weeks, and which may ultimately involve him in odium as well as in loss of money.

The appointment of analysts is vested by the bill in vestries and boards, the members of which are not unfrequently tradesmen or intimately connected with them, and it does not seem probable that these will be particularly anxious to appoint a man to test the purity of their goods; consequently it may be predicated with great certainty that in many parishes they will never be made to see the necessity for appointing such an official; and even where members would be willing enough to elect an analyst if it were compulsory on them to do so, they will hesitate and avoid doing so if it is optional, when they know that the tradesmen on whom depends their re-election will in every probability select other representatives to fill the place of those who saddled them with inquisitors. Besides there is no good reason why, if it be desirable in the interest of the public that analysts should be appointed that the appointment should not be compulsory. Then, again, the analyst, even when appointed, is not bound to visit shops and purchase specimens, and putting the act in force against adulterators is left to the public at large, not a very satisfactory guarantee for its enforcement, seeing that what concerns people in general is not considered the business of any individual in particular. No doubt vestries may make it a condition on appointing an analyst that he should do this, but for the reasons stated above it is not likely that they will. In Paris, where the health of the public is considered of some importance, the authorised officials are the responsible persons, and it is no uncommon circumstance for one of these to stop a milkman in the streets, and carry away a certain quantity of his milk for analysis.

As regards the punishment for acts of adulteration, the amount of the fine is of secondary importance; the real punishment is in the exposure and the consequent loss of custom. The mode of publication of the second conviction is left to the judgment of the magistrates who hear

the case, who will, we fear, be content to adopt that which is adopted by the Act, viz. publication in one or more newspapers. Now, thoroughly effectual as this might be in checking adulteration among the tradesmen whose customers are chiefly among the higher class, it would be of little effect among those who live in poor neighbourhoods, the inhabitants of which never read a newspaper. We repeat, that the only effectual method of exposure is to adopt that which is pursued in Paris—having the offence and the punishment printed at the offender's expense, and exhibited in his shop window for a fixed period.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Process for the Separation and Estimation of Phosphoric Acid. By M. G. Chancel.[1]

M. Chancel's new process is founded on the complete insolubility of the phosphate of bismuth in liquids which contain nitric acid even in considerable quantity. When a solution of acid nitrate of bismuth (so dilute that it is no longer rendered turbid by water) is added to a liquid containing a phosphate, a very dense and beautiful white precipitate is formed, which falls very rapidly and leaves the liquid perfectly clear. A great many analyses and syntheses have demonstrated that the composition of the precipitate so obtained is constant, and is represented exactly by the formula

$$Bi\ O_3.PO_5.$$

The salt, therefore, is a neutral phosphate, since the triatomic molecule of the oxide of bismuth replaces the three molecules of water of the tribasic phosphoric acid.

The neutral phosphate of bismuth is quite insoluble in water[2], and dilute nitric acid either cold or boiling, but soluble in liquids containing much of the ammoniacal salts. The filtration of the liquor in which it may be suspended requires no particular precautions, and a little washing with water is sufficient to remove any traces of foreign matters in the solution; it dries very quickly, and as it is infusible at a red heat, it may be ignited without fear in a platinum crucible. The recent researches of Dumas give 210 as the equivalent of bismuth, and therefore a salt of the above composition will contain 23·28 for 100 of anhydrous phosphoric acid.

Pyrophosphoric acid $p\ PO_5$ is also completely precipitated from a cold solution by the acid nitrate of bismuth, forming a white precipitate much more bulky than that obtained with the tribasic acid. On analysis this precipitate gives results which perfectly agree with the formula[3]

$$2\ Bi\ O_3.\ 3\ p\ PO_5,$$

in which the relation of the oxygen of the base is to that of the acid as 2 is to 5. The compound is therefore a neutral pyrophosphate of bismuth: it contains 31·28 of the base for 100 of pyrophosphoric acid. Experiments demonstrate that it is the pyrophosphoric and not the tribasic acid which exists in the precipitate obtained under the conditions indicated; for if after washing the precipitate with cold water it is treated with sulphuretted hydrogen, sulphide of bismuth is formed which can be separated by filtration, and then, after removing the excess of sulphuretted hydrogen, the solution gives a white precipitate with the salts of silver. But in an analytical point of view, the most interesting property which this pyrophosphate presents, is its complete and instantaneous transformation into the tribasic phosphate, $BiO_3\ PO_5$, when heated with an excess of the acid nitrate of bismuth. It is sufficient to heat the liquid to the boiling point, at which the precipitate immediately changes its appearance and becomes much more dense. Washed and dried it has then the composition $BiO_3\ PO_5$, and decomposed by sulphuretted hydrogen it furnishes an acid which precipitates the salts of silver yellow.

The metaphosphates behave in just the same way: the precipitate only requiring a longer boiling to be completely changed into the ordinary phosphate. Decomposed by sulphuretted hydrogen it gives an acid which does not coagulate albumen, and which precipitates the salts of silver yellow after having been exactly neutralised with ammonia. All these points justify the conclusion that in estimations of phosphoric acid in the form of phosphate of bismuth it is not important to consider under what modification the acid may exist in the substance to be analysed.

The above process is not only complete but very delicate; and as the precipitation is extremely rapid in a hot solution, the liquid becoming clear almost instantaneously, it will be easy to estimate phosphoric acid with a standard solution of the acid nitrate of bismuth.

Preparation of the Reagent.—The salts of bismuth having a great tendency to split up into basic insoluble salts and acid salts, the reagent made use of must be sufficiently acid and diluted as no longer to become turbid either by boiling or by further additions of water. These conditions will be realised when the solution will contain 10 or 12 equivalents of nitric acid, supposed anhydrous, for 1 equivalent of oxide of bismuth $Bi\ O_3$. A convenient test solution for qualitative experiments, as well as quantitative determinations, may be prepared by dissolving one part of pure crystalline subnitrate of bismuth ($BiO_3.\ NO_5+Aq$) in four parts of nitric acid sp. gr. 1·36, adding to the solution 30 parts of distilled water, and then boiling and filtering if necessary. Each cubic centimetre of such a solution will precipitate from 7 to 8 milligrammes of phosphoric acid.

The separation and estimation of phosphoric acid in the presence of various bases is very simple. The matter to be analysed is weighed; if insoluble in water, it is treated by nitric acid, avoiding too great an excess. The solution is then diluted with distilled water, and the acid nitrate of bismuth is added until nothing more is precipitated. The whole is then boiled, filtered, and the filter washed with boiling water until the washings are no longer coloured by sulphuretted hydrogen. The precipitate is now carefully dried, and removed from the filter as completely as possible. The filter is incinerated by itself, and the weight of phosphate left is added to that of the principal precipitate, which is calcined at a red heat and weighed when completely cold. The weight of the precipitate, multiplied by 0·2328, will give the weight of the phosphoric acid contained in the substance submitted to analysis.

The above process, which gives remarkably exact results, only requires that the liquor shall be free from chlorides and sulphates. If these be present, the chlorine and sulphuric acid must be removed before the nitrate of bismuth is added.

[1] *Comptes-Rendus*, t. l. p. 417.

[2] It is said in Gmelin's *Handbook*, vol. iv. p. 434. to be either a white insoluble powder which fuses to a white enamel, or a crystalline salt soluble in water.—Ed.

[3] M. Chancel represents ordinary or tribasic phosphoric acid by the symbol PO_5, pyrophosphoric or bibasic acid by $p\ PO_5$, and meta- or mono-basic acid by $ss\ PO_5$.

TECHNICAL CHEMISTRY.

The New Zealand Iron Sand, and a Discovery in Iron Metallurgy.

Mr. Robert Mushet, in a long letter to the *Engineer*, expresses an opinion that the true key to the mystery of the excellence of the Danemora and other irons is the presence of titanium. Some years ago his father, Mr. David Mushet, discovered some crystals of a titanium compound in the hearth of a Norwegian blast furnace, and some of the same have since been found in furnaces in the Forest of Dean and Cleator districts, both celebrated for the excellence of their iron and the steel made from it. "Now," he continues, "as all the recognised ingredients of the ores of these districts were common also to the ores of other districts whose iron and steel were not in any way remarkable for excellence, it occurred to me that the unrecognised ingredient titanium might possibly be the true key to the profound mystery which had so long defied the efforts of chemists and practical men to unravel. I immediately procured some ores of titanium, for the purpose of experiment, and which ores I found, however, were all but unobtainable, so that I had to pay 16*s.* per ounce for some rutile, and 5*s.* per ounce for ilmenite. I was assured also that I must never expect to procure these ores in quantities beyond a few pounds' weight at the most, as they were almost the rarest of minerals. But I went to work, and by alloying small quantities of titanium with iron and steel I obtained surprising results, which at once convinced me that I was upon the right track at last. I now had the iron ores of the districts I have named carefully examined for titanium, and I found that all of them contained titanic acid, and that whichever ore most abounded in titanic acid, the iron and steel produced from that ore was the most celebrated and valuable. In reducing likewise the ores of iron and titanium I found that a peculiar slag, or scoria, was always obtained, and of such a remarkable character that it was impossible, when once seen, ever to mistake it for any other kind of iron slag; and from the colour and appearance of this slag I could at length, by experience, determine with tolerable accuracy the per centage of titanium, and therefore of titanic acid, in any given specimen of titanium ore or titaniferous iron ore. And now the whole mystery of the Danemora iron was at once elucidated, and its explanation is this—the magnetic iron ore from which the Danemora iron is prepared contains a larger percentage of titanic acid than other ores from which the inferior brands of Swedish iron are obtained, and the bar iron obtained is therefore more largely alloyed with titanium.

"Moreover, as titanium is perhaps the most difficult to fuse of all the metals, its alloy with bar iron requires a higher temperature for its fusion than that required for the fusion of bar iron destitute of such an alloy, and it is well known that the best Danemora iron, in the state of iron, is more difficult to melt than any other charcoal bar iron. It has also been observed by the steel trade that steel irons which require "much melting," *i. e.* which are difficult to melt, yield cast steel possessing great "body," *i. e.* powers of endurance when made into a tool. If any chemist will be at the pains of analysing the steel irons used in Sheffield, and seek especially for their percentage of titanium, he will find that their market value is in exact proportion to the percentage of titanium they respectively contain.

"It will, I am aware, be objected that chemists have as yet detected no titanium in these irons. I grant this, and I will explain why it has been so. Chemists confound the titanic and silicic acids one with the other, and, besides this, the insoluble residuum is likewise a form or compound of titanium. I will cite a case in point which completely confirms and proves my position. An extraordinary magnetic iron sand was brought to England from a volcanic district in the South Seas. Some of this ore was sent to me, and I perceived at once that it was an ore of titanium. On testing it by my processes, I found that it must contain at least 8 or 10 per cent. of titanic acid. I received at the same time an elaborate analysis of this ore, performed by an able chemist, who read a paper on the subject before the Chemical Society, and which analysis gave not a trace of titanic acid. Subsequently I found that another chemist had fully confirmed my experiments by finding over 8 per cent. of titanic acid in this iron ore.

"The excellency, then, of this extraordinary magnetic iron sand is due, first, to its large percentage of titanic acid, and, secondly, to its freedom from impure earthy mixture, which more or less deteriorates the quality of all iron ores, whether titaniferous or not. I have from this ore manufactured steel of surpassing excellence; samples of which are in the hands of the fortunate owner of the deposit, the value of which for steel and iron-making is incalculable. The analogy between this ore and that of Danemora has already been observed by parties acquainted with the manufacture of Swedish iron; but the explanation of the similarity was reserved for me to give. Until my discoveries upon this subject, titanium has only been alluded to as a pernicious ingredient in iron ores or iron, causing redshortness, &c. One chemist alone has remarked that titanium in small quantities does not appear to affect the quality of iron injuriously, and this remark I find in an almost obsolete French work on chemistry. The celebrated Damascus blades are made from iron reduced from a highly titaniferous iron ore. The Wootz ore of India is more titaniferous than that of Danemora. The Elba iron ore is moderately titaniferous, and so also is the Brush iron ore of the Forest of Dean. Iron alloyed with titanium possesses a degree of body and durability unknown in ordinary bar iron of good quality. First-rate steel can only be made from iron containing titanium. There is a spurious, ductile, and easily workable steel which owes its usefulness to the presence of manganese; but between which and the titanic steel there exists as wide a difference, in point of excellence, as there is between common hot-blast Scotch pig-iron and the best Shropshire or Blaenavon cold-blast iron.

"This difference is well known to the Sheffield trade. Titanium steel has "body." Manganese steel has little or none; but it is ductile and hardens well, and is cheap besides, and can be applied to inferior purposes. Not that the Sheffield steel makers ever dreamed about titanium; but what they call "body" is in intelligible language rendered correctly by the term titanium; and to the fact of this metal existing in alloy with Danemora and other Swedish bar irons to the extent of from one quarter per cent. to about one or one and a half per cent. is mainly due the rise, progress, and present prosperity of Sheffield and its manufacturers.

"When pure grey cast-iron is alloyed with titanium in certain proportions, it may, when cast into ingots be drawn into bars of great strength and tenacity. I have thus drawn an ingot of grey cast-iron 3 in. square into bars ¾ in. square, and perfectly sound.

"The specific gravity of titanium has been most erroneously assigned by chemists as 5·3. It is in reality a

metal somewhat heavier than iron, and that steel which contains a large alloy of titanium is consequently found to have a higher specific gravity than other steel. It may be objected that small proportions of titanium, in alloy with iron, cannot produce a marked effect. To this I reply that with one half per cent. of carbon, and under that proportion, are produced nearly all the marketable varieties of bar iron and steel with which we are familiar, and it is also certain that one half per cent. of phosphorus renders bar iron crystalline, and one half per cent. of sulphur occasions redshortness; therefore that so small a quantity as one half per cent. of titanium should constitute the excellence of steel iron is not at all an anomaly. Magnetic iron ores always contain some titanic acid, and such is its efficacy in improving the quality of iron, that the most impure magnetic ores, abounding with pyrites, nevertheless, yield iron of a superior class. If the iron used in the manufacture of rails was prepared from pig-iron, smelted from ordinary iron ores, with the addition of a tenth part of titanium, or even one-twentieth, the rails thus manufactured would be at the least four times more durable than they are found to be under the present processes of manufacture. This is only one of the many important results which the discovery of the effects of an alloy of titanium upon iron will lead to. The deposit of titanium ore of the iserine variety, to which I have alluded, extends twenty miles in length by half a mile in breadth, and has no bottom at four yards in depth. It is all of one uniform quality, in the state of iron sand, so minutely divided, that of half a ton which I have had, the whole of it readily passes through the meshes of a sieve of 3600 holes to the square inch, that is to say, the largest grains are not so much as one 3600th part of an inch[1] in diameter. From my experiments with iserine heated and immersed in water, I am of opinion that the whole of this extraordinary deposit of iron sand has been, when at an intense temperature, suddenly quenched in water. It probably existed in the interior of a volcano, into which at some epoch an irruption of the sea has taken place, and the sand has been thrown out by the force of the explosion which must have ensued. The region is volcanic, and there are lofty extinct volcanoes near the locality of the deposit.

"Reckoning 30 cwt. per cubic yard as the weight of this sand, the number of tons in the area already ascertained of this deposit will amount to 185,856,000 tons, a quantity sufficient to furnish a supply for all the furnaces in England with ore for twenty-five years."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, 5 *April* 1860.

DR. A. W. MILLER, *in the Chair.*

DR. ANDREWS, *F.R.S.* delivered a discourse *On Ozone.* Van Marum appears to be the first who observed that oxygen through which electrical sparks have been passed acquires a peculiar odour and the power of attacking mercury. This subject attracted no further attention for upwards of half a century after the publication of Van Marum's observations.

In 1840 Schönbein made his first communication on ozone to the Academy of Munich. It was entitled *Observations on the Odour developed in the Electrolysis of Water, and the discharge of Common Electricity from Points.* In this important paper, he states that in the electrolysis of water, an odorous substance appears at the positive pole, that this substance may be preserved for a long time in well-closed vessels, and that its production is influenced by the nature of the metal which serves as the positive pole, by the chemical properties of the electrolytic fluid, and by the temperature of that fluid or of the electrode. The same effect was produced by holding a strip of platina or gold near the knob of the prime conductor of an electrical machine in good order. With great sagacity he also recognised the identity of the peculiar odour which accompanies a flash of lightning with that under consideration. In this paper Schönbein supposes the odoriferous principle, for which in a note at the end he proposes the name of ozone, to be a new electro-negative element belonging to the same class as chlorine and bromine. In a subsequent memoir, he hints that it is not only an elementary body, but a constituent of nitrogen.

Schönbein soon afterwards discovered that the same substance is produced when phosphorus is slowly oxidised in moist air or oxygen gas.

In the following year he returns to the consideration of the nature of ozone, and partly from his own observations, partly from experiments communicated to him by De la Rive and Marignac, he concludes that ozone is not a constituent of nitrogen nor a simple body, but an oxide of hydrogen, different from the peroxide of hydrogen of Thénard; and draws the conclusion that its constitution must be similar to that of chlorine, which possesses analogous properties. He is therefore led to adopt the old hypothesis of Berthollet regarding the compound nature of chlorine.

In a communication made to this Society by Dr. Williamson, in May 1845, that distinguished chemist gave an account of some experiments from which he concluded that the peculiar properties belonging to the oxygen set free by the agency of the electrical current, are produced by the admixture of a peroxide or acid of hydrogen, and that by the action of phosphorus on atmospheric air the same substance is not produced.

About the same time, or a little earlier, an important set of experiments on the same subject was communicated by M. Marignac to the Academy of Sciences. The following are the chief conclusions to which Marignac arrived:—

1. In the decomposition of water charged with sulphuric acid by the pile, the production of ozone is independent of the presence of nitrogen.

2. Air perfectly dry does not produce ozone when passed over phosphorus, nor air deprived of its oxygen, even if moist; nor pure oxygen, nor carbonic acid, nor hydrogen.

3. Ozonised air loses its properties when heated to a temperature of from 300° to 400° C.

4. Ozone is not absorbed or altered by water, concentrated sulphuric acid or chloride of calcium.

5. It is absorbed with great facility by iodide of potassium. (The last three properties had been already discovered by Schönbein.)

6. Ozone is easily absorbed by the metals, but if it be perfectly dried it yields nothing to silver, nor to copper, nor even to zinc.

In a subsequent inquiry conducted by Marignac, in conjunction with De la Rive, the important observation was made that ozone is produced by the action of the electrical spark on pure and dry oxygen.

A very elaborate memoir on the action of the electrical spark upon oxygen, by Frémy and Becquerel, was published in 1852 in the *Annales de Chimie.* In this memoir the authors show that pure oxygen, contained in a tube inverted over a solution of iodide of potassium, is entirely absorbed by that liquid if electrical sparks be passed for a sufficiently long time through the gas. This fact is certain, and I have myself had occasion frequently to verify it. But I have not been able, in repeated trials, to convert the whole of a given volume of dry oxygen into ozone by passing the electrical spark through it.

It is perhaps scarcely necessary for me to do more than allude to the experiments of Baumert, and to those which I myself communicated some time ago to the Royal Society. It may be sufficient to state that Baumert arrived at the conclusion that the active substance which accompanies electro-

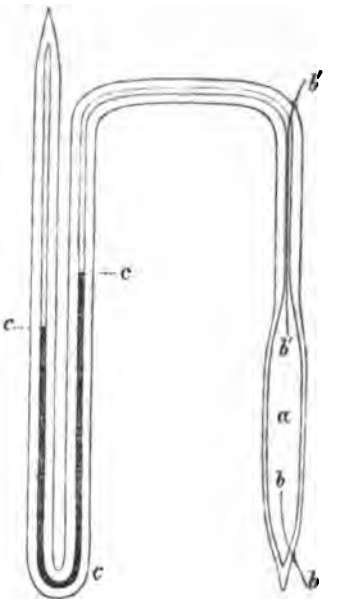
[1] 60th part of an inch?—ED.

lytic oxygen is a teroxide of hydrogen, and different from the substance produced by the electric spark on pure oxygen. My own experiments led to a different result. I found that the iodine corresponded exactly to the weight of the ozone, and, further, that in the decomposition of large quantities of ozone by heat (quantities which, if ozone were a teroxide of hydrogen, should have yielded in different experiments from 10 to 14 milligrammes of water) not a trace of water was formed. In other respects, the properties of ozone prepared by the electrical discharge and by electrolysis, were found to be the same.

Schönbein having finally rejected both his earlier views of the constitution of ozone, and adopted the view (first suggested I believe by Marignac) that ozone is an allotropic form of oxygen, has recently given a remarkable extension to this hypothesis. Having observed that on agitating air containing ozone with a certain quantity of the peroxide of hydrogen, the ozone reactions disappear, and at the same time the peroxide is reduced to water, he concludes that oxygen, as it exists in ozone and in the second atom of the peroxide, is in two active but opposite states. The former he designates negatively-active, the latter, positively-active oxygen; or ozone and antozone, symbolised by Θ and $\oplus$. From the union of an equivalent of positively active oxygen with an equivalent of negatively active oxygen, common or inactive oxygen is formed. He also considers the higher atom of oxygen in the peroxides of manganese, lead, nickel, cobalt, bismuth, and silver, as also in the manganic, chromic, and vanadic acids, to be in the negatively active or ozone condition, while in the peroxides of barium and strontium, and of the alcaline metals, it is in the positively active or antozone state. Pushing these views still further, he ventures to express in symbols the supposed composition of chlorine as $MnO + \Theta$, corresponding to that of the peroxide of manganese $MnO + \oplus$.

The speculations of Schönbein bear a striking resemblance to certain views of chemical changes which were proposed some years ago by the President of this Society. In a paper communicated to the Royal Society, and afterwards published in its *Transactions*, Mr. Brodie suggests that in many chemical reactions different equivalents of the same element are thrown into opposite polar conditions, and he employs almost the same form of symbol as Schönbein to represent these opposite conditions. He also distinguishes between the isolated element, the particles of the element at the moment of their chemical separation or synthesis, and the combined element.

The Lecturer then proceeded to state that his object was to determine the volumetric relations of ozone to common oxygen, for the purpose of throwing some light on the true nature of this singular body. He would first assume the allotropic hypothesis to be true; on that assumption the question would resolve itself into the determination of the relation which the density of ozone bore to that of oxygen. The first experiments were performed with ozone obtained by the electrolytic decomposition of dilute sulphuric acid, in which case the amount obtained is not above the 200 or 300th part of the volume of the gas, under the most favourable conditions. The determination of such a change of volume as this was a most difficult matter. But after some time he succeeded in devising an apparatus which proved that a very considerable expansion occurred when ozone was changed into oxygen. This consisted of a bent tube containing a rather large reservoir. This tube is connected again with a syphon-tube of capillary bore. It is easy to fill this apparatus with carefully dried oxygen by displacement, and when certain that the whole of the tube is filled with oxygen, one leg of the syphon-tube was filled with sulphuric acid, and the lower end of the tube was sealed by directing a blowpipe jet upon it. A tube of the kind above described when the reservoir is large is so delicate that the variations in the level of the sulphuric acid are pretty nearly in proportion to the variation of the atmospheric pressure, and it was found that a variation of one millimetre or one twenty-fifth of an inch in the height of the column of sulphuric acid corresponded to a variation of one five-thousandth of the



a. The reservoir for the oxygen gas.
b b. b' b'. Platinum wires, sealed into the tube.
c c c. Column of sulphuric acid in the syphon tube.

volume of gas, or to the 20-thousandth part of its volume if read to a quarter of a millimetre. In this form of apparatus there was no difficulty whatever in ascertaining that a notable increase in bulk occurred when the ozonised oxygen was heated. The vessel was placed in an air bath over a lamp, and a temperature of 300° C. readily obtained. And in this way it was found that, in the case of electrolytic oxygen, after heating the tube, an expansion of 8 or 10 millimetres frequently occurred, as measured by the sulphuric acid in the syphon-tube.

Having very briefly described the form of the apparatus employed, the Lecturer proceeded to consider the best means of producing ozone and the change which took place in oxygen under the influence of the electric spark or discharge. Rühmkorff's coil had not been used in any of these experiments, it being entirely inapplicable, owing to the heat destroying the greater part of ozone as soon as formed. Even the spark derived from the ordinary machine interfered very much with the production of ozone. The *spark* was obtained from an electric machine about 18 inches diameter, placed opposite a fire and turned by means of a large multiplying wheel. The machine performed 350 revolutions per minute, and gave in the same time 600 dense sparks, and decomposed sufficient water to produce ·0002 cubic centimetres of the mixed gases. The other form of discharge, which was by far the most important, was the silent discharge produced by passing the electric discharge between two fine points without any visible phenomenon in daylight. (If it were possible to produce a discharge which would be invisible in the dark, he believed we might proceed much further in the production of ozone). This was obtained by connecting one of the platinum wires with the machine and the other with the ground and turning the machine rather slowly.

The Lecturer next proceeded to give the details of the experiments which he had performed in conjunction with Professor Tait. An apparatus similar to the one above described was taken, and oxygen gas prepared from chlorate of potash was passed through it, several precautions being taken

to insure the oxygen being perfectly dry and containing no admixture of atmospheric nitrogen. Having filled the apparatus, into which were previously fused a couple of platinum wires at convenient distances, it was sealed in the ordinary way. The height of the sulphuric acid column was read off, and after passing the electric discharge through it for about twenty minutes, it was found that the sulphuric acid fell from 1 to 3 inches according to the length of time. The same vessel was then taken and introduced into the air bath, heat was applied to it, and it was found that the gas returned to exactly the same volume as before. This experiment had been repeated with the same tube for 20 or 30 times. The contained oxygen had been changed into and from its ozone condition without any loss of its original volume.

The Lecturer then proceeded to give an account of the principal results which he and Professor Tait had obtained. They were briefly as follows: — When the silent discharge was passed through perfectly pure and dry oxygen, its volume changed rapidly at first, and afterwards more slowly, until it attained a contraction of one-twelfth of the original volume of the gas; that was the extreme result, and only to be obtained when the oxygen was perfectly pure and free from nitrogen. And when this ozone is heated to 300°C. it is restored to its original volume. This extreme contraction also slowly diminishes if the vessel is allowed to stand for some days, but whether this diminution would ever come to an end had not been determined.

The volumetric results which were obtained when metals and other bodies were brought into contact with ozonised oxygen gas were next described. The details of a great many experiments were described which had been undertaken with the view to ascertain what contraction was experienced when the ozone in one of these tubes was absorbed by iodide of potassium, mercury, or other substance, but the result in every case showed that there was not the slightest contraction in the volume of the gas in the tube when the ozone was removed from the oxygen, the volume of ozone thus appearing to be *nil*. These results were considered to be so remarkable and so entirely inexplicable in any received view of the subject that two other series of experiments of a very laborious kind were undertaken in order to test the correctness of this conclusion with greater accuracy, but the uniform result of all these experiments indicated *no volume* for the ozone within the limits of the errors of experiments; or to express it otherwise on the allotropic hypothesis, it gave an *infinite density* to ozone — that of a fluid or a solid rather than of a gaseous body.

The action of the electric discharge on compound gases was next described. The most remarkable of the results so obtained was when pure carbonic oxide was submitted to the action of the silent discharge. Upon passing the silent discharge through a sealed tube of carbonic oxide, it was found that in the course of a quarter of an hour the positive wire was covered with a bronze coloured deposit, while the negative remained unaffected, unless the experiment was continued for a long time, thus appearing to indicate polar action in the decomposition of the gas. If the action were continued for sixty hours, the gas would be completely decomposed by the action of the silent discharge, and would contract to one third of its volume. As it proceeds, the negative wire would become tinged, and the tube coated with the yellow body; it was impossible to determine the nature of this substance by any chemical analysis because of its extremely small quantity; it can only be ascertained by analysing the residual gas. It appears to be soluble in water, for if the wire with this deposit upon it were moistened with water the deposit would entirely disappear and the platinum recover its colour.

In conclusion, the Lecturer made some remarks upon the different theoretical explanations that could be given of results apparently so singular. About the general facts there could be no doubt at all, but with regard to the key to the phenomena that was another question. If the allotropic hypothesis of the nature of ozone were adopted in its simplest form, there seems only one way of accounting for its absence of volume, namely, by supposing that when ozone comes in contact with iodide of potassium, one part of it changes into oxygen and the other part combines with the liquid, and that these two are so related to each other that the expansion due to one is exactly equal to the contraction due to the other. On this view, we should have no means of determining what the density of ozone really is, but its density must be greater than that of oxygen. Finally, we have another possible view which will explain the phenomena, and that is that oxygen gas may be a compound body and undergo decomposition.

The Chairman expressed the thanks of the Society to Dr. Andrews, who had come over from Belfast for the purpose of giving this lecture.

Professor Williamson had very great pleasure in listening to Dr. Andrews; this certainly appeared to him by far the most careful and complete quantitative investigation published on the subject. He agreed with Dr. Andrews when he said that facts must go before theory; and in devoting himself to these volumetric researches his experiments seemed admirably calculated to secure accuracy. The subject of ozone had attracted the attention of many scientific men, and had led to so many misconceptions and popular fallacies of a really mischievous kind (for every error must be mischievous more or less) that he thought it desirable to rectify, to some extent, one or two of the more important of those popular errors or fallacies. He should be very sorry to detract in any way from the merits of M. Schönbein. We owed to him the original stimulus and many original facts; but he must refer to the wonderful number of theories which M. Schönbein had propounded, and with the wonderful rapidity with which he changed them. He (Professor Williamson) did not know anything upon which so many different theories have been promulgated. He thought the word ozone was applied to a number of reactions and effects which are not as yet proved to be. Some persons assumed that whenever iodide of potassium was decomposed that ozone was present. Now, the difficulty in chemistry was to find a substance which did *not* decompose iodide of potassium. Every acid present in the air stronger than carbonic acid must produce that particular effect which is attributed to ozone. But there is also an exceedingly numerous class of oxidising agents, such as hyponitrous acid, and some organic compounds such as turpentine, &c. which appear to have been first noticed by Schönbein himself, and any of these substances present in the air would produce the particular effect which is considered to be a proof of the presence of ozone. He would wish to allude specially to one part of Dr. Andrews' papers, namely, the theoretical conclusion to his most exceedingly valuable results. He hoped it would not be thought presumptuous in him to enter into that subject, which was really one of considerable importance. He alluded especially to the circumstance so clearly proved by Dr. Andrews, that when ozone is *decomposed* by a metal, or by iodide of potassium — he would not say *condensed* but *decomposed* — that no diminution of volume takes place. Now he should be disposed to submit to Dr. Andrews' consideration a mode of stating that fact different from the one which he had adopted, that is, he should consider it as merely a removal of oxygen from that compound, or from that condition in which it produced the reactions of ozone. He agreed most fully that the fact of no diminution of volume taking place when ozone was removed from the gaseous mixture, proved that the oxygen which was taken away was combined with something else in the tube. Whether with another atom of oxygen, or whether with water or something else, the hypothesis would still be consistent with the fact. He considered that we were forced to believe that the particular oxidising gas must have contained some compound of oxygen, and he must confess that he should consider ozone to be a teroxide of hydrogen rather than allotropic oxygen. He thought that the experiments which Professor

Bunsen made some years ago with such well known care, showed as clearly as can be that ozone formed by electrolysis was something more than oxygen, and was not the only ponderable matter carried over.

Dr. Andrews stated that he had omitted one possible cause and that is the consideration that oxygen might contain a small portion of some other body, which might possibly be an explanation of the whole phenomena. There was only one point to which he wished to refer; he could not imagine that any form of ozone obtained by electrolysis contained hydrogen. No doubt ordinary oxygen did act on the acid solution of iodide of potassium, but it only amounted to one-twentieth part of the effect observed, and, moreover, would have effected both sides of the equation. Further, the numerous experiments he had made for the purpose of detecting the presence of water as a result of the decomposition of ozone have all failed whether the ozone was obtained by the electric discharge or other processes. In fact, he could not conceive the possibility of the hundredth part of the amount of hydrogen being present in his tubes of oxygen, which would be necessary on the assumption that ozone was a teroxide of hydrogen.

Dr. Hofmann was extremely interested in the peculiar manner in which the electric discharge acted upon the carbonic oxide. Professor Buff and himself had made a series of experiments upon a different principle; they wanted to obtain volumetric results capable of being exhibited as lecture experiments. They used the discharge from a Rühmkorff's coil. He wished to know from Dr. Andrews whether the bulk of the gas in the carbonic oxide tube was increased, and what was the volume of the gas after the decomposition had taken place.

Dr. Andrews could not answer Dr. Hofmann's question very definitely, as the experiments were not quite completed. With regard to the results, if the discharge was passed through the gas for about sixty hours, until the gas is contracted to about one third of its original volume, the residual gas consisted of carbonic acid, oxygen, and carbonic oxide. The proportions were determined, but were not given, as the results were not always identical.

Dr. Hofmann stated that the passage of the spark current through carbonic oxide did not produce any effect within twenty-four hours. With regard to sulphurous acid, there was for some time no effect produced with the spark current; but after two or three hours a contraction took place, and a peculiar yellow deposit was obtained. He had succeeded in producing a very considerable contraction; and the deposit was obtained in such quantity that they were enabled to examine it. It was found to be a compound of anhydrous sulphuric acid and sulphur. On addition of water, sulphur was separated in flakes, and the solution contained free sulphuric acid. It would be interesting to compare the production of the yellow body, in the case of the carbonic oxide, with the production of this substance from sulphurous acid.

PHARMACEUTICAL SOCIETY, 4 *April* 1860.

T. N. R. Morson, *Esq. President, in the Chair.*

The first paper read was *On Tallicoonah Oil*, by Mr. R. Clark. This article, known also as *Croupee* and *Coondee*, is obtained from the seeds of a tree which grows abundantly at Sierra Leone, and other places on the west coast of Africa. The fruit of the tree, which ripens in March and April, is a globular capsule, containing four or five seeds. These latter are dried by the natives, who then beat them into a pulp, which is boiled with water in large clay pots, and the oil is skimmed off as it separates. In some places the seeds are roasted before they are beaten into pulp. The oil is preserved by the natives in large wooden troughs furnished with lids. When carefully prepared it burns well, but, as usually obtained, it gives a smoky flame. It is a drying oil, and answers well for paints. The price of it on the Gold Coast is 1*s.* 9*d.* per gallon, and at Cape Coast 2*s.* per gallon. Owing to the difficulty of introducing a new article to commerce, no great quantity had been exported from Africa, but some had been sent to America, where it had fetched the same price as palm oil. If a demand for it were to arise, very large quantities could easily be obtained. It is soluble in ether. Alcohol dissolves a part of it, and separates a concrete fat. The natives use the oil as an anthelmintic, administering from one to two ounces to robust adults. The effects resemble those produced by castor oil. According to the author, it must be used with judgment, for an overdose excites severe vomiting and cold sweats. For ascarides it is very effective, when used in the form of an injection. It is used, besides, as a liniment for rheumatism, and as an application in some skin diseases. The oil has an extremely bitter taste, which seems to be shared by all parts of the plant from which it is obtained, and probably belongs to an alkaloid which has not yet been separated.

Mr. Hanbury said that the seeds had been imported in large quantities, and he had seen some hard fat which had been obtained from them by hot-pressing. The residual cake, he thought, would yield the bitter principle.

The next paper was on *Taraxacum*, by Mr. T. B. Groves. The author said he had collected the plant at all seasons of the year, and he believed that October was the best month to collect it for the extract. He had also prepared some extract according to the process given in the Pharmacopœia, and had found that the extract so prepared had no similarity to any in commerce. It was an opaque tenacious mass, with a mawkish taste, which made with water a whitish opaque fluid. According to Pereira, the extract is bitter and aromatic, but that found in commerce is always sweet. The author recommends the following process for the preparation of the extract. The roots collected in October are sliced and pressed, by which means about half their weight of liquor is obtained. This is heated and then strained, afterwards evaporated for some time and strained again, and then the evaporation continued to a proper consistence. Such an extract can be preserved for any length of time by placing it in covered pots, sprinkling the surface with alcohol, and hermetically sealing the pot by means of a strip of sticking plaster. The fluid extract should be made from the fresh roots collected at the same time of the year. They should be quickly cleaned, sliced, and pressed. If half their weight of liquor is not obtained, it should be made up with water. The juice must now be evaporated to half its volume, and one fourth of spirit added. It must now be filtered and the residuum gently pressed. The author insisted on the necessity of some single process for the preparation of the extract. In consequence of its being prepared in various ways from roots collected at different times, it was difficult to find two specimens quite alike. The liquors differed still more. He hoped the forthcoming Pharmacopœia would rectify this state of things by giving authoritative directions for the preparation of both liquor and extract. The consequences of the differences in these articles are sometimes disastrous to a druggist who has not a "historic name" to sustain his credit, for patients always believe that the medicine first made up from a prescription is correct, and any variation in appearance or taste, afterwards, is the result of a mistake on the part of a dispenser.

The Chairman agreed in the necessity of uniformity in the mode of preparing these medicines, and Professor Bently reiterated his opinion that the proper time for collecting the roots was the spring.

Mr. Haselden then made some remarks on the preparation of plasters. He objected to the form for *emplastrum opii* in use, which makes a plaster which runs, and goes through the leather. He thought the gum *thus* might be advantageously replaced by *emp. resinæ*, and the opium by a solution of morphia. He recommended that the following form should be adopted in the new Pharmacopœia:—

Lead Plaster	ʒvj.
Resin Plaster . . .	ʒiv.
Acetate of Morphia . .	ʒj.
Acetic Acid	℥lv.
Water	ʒiv.

Dissolve the morphia in the acid, diluted with the water; add them to the melted plasters, stir and keep hot until all water has been driven off. The *emplastrum belladonnæ* was objected to on account of its disagreeable smell and its want of adhesiveness necessitating a margin of lead plaster. In the Pharmacopœia of 1836 the extract of belladonna was ordered to be mixed with resin plaster, but this made an irritating instead of an anodyne application, and in the next Pharmacopœia the quantity of extract was doubled, and it was united with soap plaster. The result was a soft plaster which would not adhere. The author said that *atropine* might be used in this case to replace the extract of belladonna, and the form he suggested was the following:—

Lead Plaster	3vj.
Resin Plaster	3iv.
Atropine	grs.iv.
Acetic Acid	3ij.
Water	3iv.

The atropine should be dissolved in the acetic acid and then mixed with the melted plasters, and the heat continued until all the water and acetic acid had evaporated. No trial had been made of this plaster, but the one prepared with morphia had been tried, and found as efficacious as the plaster of opium.

The CHAIRMAN said that there was one objection which he thought was fatal to the use of atropine in plasters. It was completely destroyed at a temperature a little above that of boiling water. There was no such objection to the use of morphia, but he had some doubts of its value when locked up in a hard resinous plaster. The value of opium in a plaster he thought was much over estimated. He had had a man engaged in pulping 2 cwt. of opium, an operation which lasted several hours, during which time the man had his naked arms constantly immersed in a strong solution of opium, and yet he had never seen any narcotic effect produced.

Mr. WHIPPLE said he had seen men affected by the evaporation of extract of opium.

Mr. ROBBINS and Mr. HANBURY told of cases in which severe effects had followed the application of a belladonna plaster. In that related by Mr. Robbins death almost ensued.

The next paper was *On the Adulteration of Carmine*, by J. ATTFIELD, *Demonstrator of Chemistry at St. Bartholomew's Hospital.*

The object of the author in this communication was to draw attention to the fact that carmine is largely adulterated with dichromate of lead, and to point out the enormous extent to which vermilion is used for the same purpose.

After describing what commercial carmine should be, and noticing its use by artists, confectioners, red ink makers, &c. the author proceeded to detail the method adopted in the examination of fifteen samples of this pigment, obtained from the retail shops of chemists and druggists, and artists' colourmen, in various parts of London. It mainly consisted in dissolving out the carminic acid, or pure carmine, by ammonia, the dichromate of lead by hydrochloric acid, and estimating the vermilion left insoluble. Alumina and oxide of tin, being necessary ingredients of commercial carmine, were not reckoned as adulterants. Other possible adulterating agents were looked for, but not detected. The most convenient quantity for examination was found to be one decigramme.

In determining the actual value of the respective specimens, number one was taken as the standard, the worth of the others being calculated from the per centage of carmine contained in them.

The difference in the cost of equal quantities of the samples was pointed out as somewhat remarkable, the poorest specimens generally costing most money; and even where reduction in quality was accompanied with reduction in price the former far outran the latter.

Finally, carmine should be completely soluble in solution of ammonia, and attention should be paid to the purity of tint and comparative depth of colour of the resulting solution.

A diagram, exhibiting the composition of the several samples, was suspended in the theatre; the following table is an abridgement of it:—

	Carmine.	Alumina.	Vermilion.	Chrome red.	Cost of 10 grains.	Actual Value.
I.	99·4	·6			5*d.*	5*d.*
II.	63·0	6·0	31·0		5*d.*	3½*d.*
III.	35·5	2·0		62·5	10*d.*	2*d.*
V.	76·7	3·6	19·7		10*d.*	4*d.*
VI.	46·6	3·4	50·0		3½*d.*	2½*d.*
VII.	26·8	2·0		71·2	3*d.*	1½*d.*
X.	28·3	6·0	65·7			
XII.	96·2	2·5			7*d.*	5*d.*
XIV.	23·0	trace	77·0		1*s.* 5*d.*	1½*d.*

The CHAIRMAN announced that owing to the Annual Meeting, and the Conversazione, there would be no Ordinary Meeting in May.

NOTICES OF BOOKS, PATENTS, &c.

On the Educational Uses of Museums. By Professor EDWARD FORBES. London: Longmans, 1853.

A MUSEUM really illustrative of chemical science has yet to be formed; the chemist may, however, learn what is to be avoided in forming one, and may also derive great advantage from a study of the collections devoted to other sciences. "An assemblage of curious things," is still often considered an adequate definition of what a museum is and should be. But the mere gathering together of things curious, rare, or beautiful (such are the objects supposed to be requisite), is but the first step in the formation of a museum. Classification must follow collection; while description, in whatever way conveyed, is also necessary before a museum can secure its full and real power of instruction. The founders or curators of many, if not of most museums, seem to think that their task is but to form, maintain, or increase a heterogeneous collection of objects. On this point the late Edward Forbes makes the following remarks, still, alas! too appropriate, in his admirable lecture "On the Educational uses of Museums," now before us, which we will take as the text for a few words on museums, and their relation to chemistry:—

"Unfortunately not a few country museums are little better than raree-shows. They contain an incongrous accumulation of things curious or supposed to be curious, heaped together in disorderly piles, or neatly spread out with ingenious disregard of their relations. The only label attached to nine specimens out of ten is, 'Presented by Mr. or Mrs. So-and-so;' the object of the presentation having been either to cherish a glow of generous self-satisfaction in the bosom of the donor, or to get rid — under the semblance of doing a good action — of rubbish that had once been prized, but latterly had stood in the way. Curiosities from the South Seas, relics worthless in themselves, deriving their interest from association with persons or localities, a few badly stuffed quadrupeds, rather more birds, a stuffed snake, a skinned alligator, part of an Egyptian mummy, Indian gods, a case or two of shells, the bivalves usually single and the univalves decorticated, a sea urchin without its spines, a few common corals, the fruit of a double cocoa-nut, some mixed antiquities, partly local, partly Etruscan, partly Roman and Egyptian, and a case of minerals and miscellaneous fossils, — such is the inventory and about the scientific order of their contents."

A long-established and somewhat extensive museum in the English lake district affords a striking instance of the entire absence even of an attempt at systematic arrangement. It requires a more profound attention than most visitors can be called upon to give, in order to discover the connection between the following objects arranged in the closest proximity in Crosthwaite's Keswick Museum, — a cluster of 55 nuts from Greystoke Park — chain armour of the time of Stephen — a stuffed char — slippers of rattlesnake skin — the helmet of an Irish dragoon! Again, what abstruse relation is there between a Chinese churn, a monster bamboo, the prow of a Russian ship ornamented with mica, the skin of a conger eel? But this museum, it will be said, is a private one, and in a remote and rural district. Let us visit, then, one of the most celebrated homes of learning.

What is the present state of the only Oxford museum that makes any attempt to illustrate the circle of the natural sciences? We cannot do better than quote the words of an Oxford guide-book; a guide-book which has the usual failings of such works, but which yet gives, in the extracts that follow, a fair idea of the collection known as the Ashmolean Museum. Let us premise that the specimens described are said to have been "arranged with the greatest accuracy by J.S. Duncan, D.C.L., according to the best recognised system." Now for the development of this admirable system: —

"Left of the entrance to the staircase are various skeletons and a collection of heads and feet of birds and quadrupeds: together with a fine collection of the heads of antelopes from the Cape of Good Hope, presented by H. Methuen, Esq.; also a model representing the nerves of the human face, by Mr. Paxton of Oxford; the head of a New Zealand chief who was killed in battle, &c. On the right of the room is a numerous assortment of the ingenious work of Asiatics, Africans, and other uncivilised nations.

After passing some Indian canoes arranged with great taste upon fragments of Egyptian sarcophagi, the visitor will find himself upon the staircase. Here is a varied collection of paintings: —

"A portrait of old Parr taken at the age of 152; an ancient and curious historical picture of the battle of Pavia; a drunkard; an idiot tormenting a cat; a gamester; a dead Christ, by Annibale Caracci (?); John Selden at an advanced age, and Louis XI. of France."

Another extract, completing the description of this interesting but miscellaneous collection (in which there are, it must not be forgotten, some almost priceless treasures), will be sufficient for the present purpose.

"On entering the second room, opposite the door is a large magnet supporting a weight of 160 lbs. To the left of the door, and at the west end, are lofty glass cases containing a splendid collection of stuffed birds. Near the first window is an ancient chair of the time of Henry VIII.; in the window-place is the head and foot of the dodo, a bird now extinct; also a curious rattle cut by a shepherd, and an ancient gag. Near the second window-place is a model of the Druidical monument at Stonehenge. Against the wall, opposite the entrance, are cases of reptiles and fish, in spirits and otherwise. In the fifth window-place, is a model in plaster of the field of Waterloo, representing the position of the contending armies when the Prussians approached; also a Babylonish brick. To the right of the window is a portrait of Mary Davis, on whose head grew two horns, which she shed twice (one of them being preserved in a glass case adjoining), and a variety of stuffed quadrupeds. Over these cases is a fine collection of the horns of ruminating animals."

The next curiosities are the following: —

"Christ bearing his cross, executed with the feathers of the humming bird; an ancient peg tankard (it having formerly been the custom for each person to drink from one peg to the other, and if he should drink more or less, to pay a fine); Burmese idols; fragments collected by Belzoni in the Egyptian catacombs; British and Roman relics from tumuli in Kent, Sussex, &c. and numerous other valuable curiosities."

The former curators of the Ashmolean Museum seem to have steadily kept in view the assertion of Plato: — "There can be no science of things perceived by the senses."

No doubt the New University Museum, under its present able curator, will present, when the collections are arranged, a very different aspect.

On what system have the contents of such museums as those we have noticed been arranged? Has the leading idea been that colour, that size, were the chief characteristics of nature? Regarding the specimens as curiosities, was it thought that ridiculous juxtaposition would enhance their curiousness? Why are badly stuffed animals so generally preferred to carefully articulated skeletons, the study of which would prove so much more instructive? The shabby rhinoceros and the dilapidated giraffe met with in so many museums are certainly of very slight educational value.

But it will no doubt be urged, "How is it possible to arrange the miscellaneous objects which usually constitute such collections?" Let only a clear idea of one principle of arrangement be formed and retained, and a partial success will at all events be achieved: an accurate catalogue and full descriptive labels will aid in the accomplishment of this result. Let us recount briefly some of the principles on which the contents of museums may be classified.

It might at first sight appear that the ideas of time and space would afford suitable grounds for the primary collocation of objects. But it will be found that historical succession and geographical distribution (for by these terms we must interpret the ideas of time and space respectively) will lead to awkward juxtapositions of wholly dissimilar objects, the relations of which will thus be distant and obscure. Still special purposes will sometimes justify and even require such arrangements, though generally the lesson to be taught would be difficult and the profit small. It needs no argument or illustration to prove that mere outward similarity, as a basis of classification, would involve numerous difficulties and absurdities. But it seems that a triple division into matter, force and life, will exhaust that aspect of the earth under which natural history and natural science present it to our attention. We may thus arrange our various collections in accordance with the three divisions of natural science — biology, physics, and chemistry. In each of these divisions certain theoretical or essential and also certain phenomenal sciences will be grouped: thus biology will include not only comparative anatomy, animal and vegetable physiology, but also descriptive zoology and botany, both recent and fossil. Moreover, all three divisions are linked together in many ways, which in a museum may be exhibited in the arrangement of the specimens illustrative of these connecting sciences.

To the comparative anatomists, physiologists, zoologists, botanists, palæontologists and physicists of the present time, may well be left the task of remodelling and perfecting the collections illustrative of their several sciences; the chemist, however, as yet has scarcely, if at all, employed the museum as a means of instruction in his department. In his lectures and his laboratory, to be sure, chemical apparatus and chemical products are constantly shown and described, but this is not in every respect equivalent to the uniform, intelligible, and patent classification which an extensive and well-arranged chemical museum might exhibit. Such a collection might serve many purposes, and might almost be made to describe itself. The enlightened chemist, taking warning from the failure, and learning from the success of other museums, will readily find a way of forming an instructive chemical collection. He will not, for instance, pursue the plan which appears to have been adopted in arranging the specimens presented to the Chemical Society of London, where the size of the bottles seems to have furnished the principle of classification. One might as well arrange a library into groups of folio, quarto, and octavo books, wholly regardless of their contents. But the specimens in a chemical museum should be so ordered and labelled as to illustrate the types, the notation, and the nomenclature of the science; while models of crystals and apparatus, together with diagrams and drawings, will serve to illustrate crystallography, chemical processes, and the arts dependant thereon, as well as to familiarise the student with chemical symbols, formulæ and reactions.

New or Improved Methods of Manufacturing a certain Metallic Compound or Alloy. Robert Mushet.

We have already noticed Mr. Mushet's patent for producing alloys of iron with tungsten or tungsten and manganese. The present patent is merely for puddling the alloy as prepared by the former process, and so rendering it malleable. He follows the common process for puddling, and states that the alloy so produced and puddled is denser and harder than ordinary iron.

Improvements in the Treatment of Iron. John Prentice Farrar.

This patent is for treating iron, while molten, with cyanogen or sal-ammoniac, which (he says) he finds to be "highly beneficial and successful in purifying cast iron, and in increasing the strength thereof."

As the patentee uses a pound and a half of prussiate of potash and two pounds and a half of sal-ammoniac to the ton of ore, or one and a half pounds of each of them to the ton of pig iron in the cupola, or to one ton of wrought iron if melted in the crucible, we confess we are totally at a loss to see what advantage he can expect to derive.

"In some cases I introduce the before-named ingredient into the ladle before tapping molten iron from the furnace, and into which ladle it may be drawn. I thus derive the action of the gases arising from the ingredients." It is these gases he looks to as his purifying and strengthening media.

As for the prussiate it will yield a little carbon, which if added to pig iron will incontinently be removed in the next process. As to two or three pounds of sal-ammoniac in the state of vapour purifying a ton of iron, we do not hesitate to say that it is a gross delusion. Mr. Farrar dates from New York. *Verbum sap.*

CORRESPONDENCE.

Arsenic Crusts.

To the Editor of the Chemical News.

Sir,—While acknowledging the ingenious character of many of Dr. Guy's adaptations, as described in his paper read before the Society of Arts, I must altogether demur to the proposed employment of flat discs of glass for receiving arsenical crusts. Except with very high magnifying powers (which are rendered unnecessary by adopting a process which I shall presently describe) a glass tube of half an inch diameter offers equal facilities for examination under the microscope. Indeed, for small crystals, even a quarter inch objective (magnifying 500 diameters) can be so employed, with the slight drawback of needing some extra focussing. On the other hand the rapid sublimation required in Dr. Guy's method must involve the loss of part of the arsenical vapour at the mouth of the tube, which is only loosely covered by the flat glass, and another portion, being very dense, will remain in the tube itself, whilst that which reaches the disc will be deposited on it in a nearly amorphous condition. No wonder that such "mists" should frequently require objectives of one-eighth inch to develop any crystallic character, and even then a few imperfect triangular facets afford but unsatisfactory evidence of *octahedralism* when we consider what weighty issues are in a measure dependent on the making out that feature. It is, however, in the power of the operator to obtain crystals of arsenious acid as perfect as he can those of alum an inch or two in diameter, and by acting on the same principle, namely, by obtaining a very gradual formation during slow cooling. The following is the *modus operandi*, as described in Table I. of my "Compendium of Qualitative Analysis." Drive the substance entirely off the lower half of the tube, which is made very hot by waving it about in the flame. Then re-vaporise the sublimate, holding the tube (which should be closed by a loosely-fitting cork) as upright as possible. The dense vapour sinks to the bottom, and will give large and regular crystals as the glass slowly cools. These crystals glitter in the sun like diamonds, and exhibit the same play of colours; they are from one one-hundred-and-fiftieth to one two-hundredth of an inch in diameter, and under an inch objective form specimens for the micro-crystallographer. Here and there we find octahedra absolutely perfect, but they are more frequently truncated; all the angles, however, being beautifully sharp. The majority are transparent, but some are only translucent, or even opaque. By reflected light (using a bulls eye condenser) they appear, in consequence of their adamantine lustre, like diamonds lying in high relief on a black ground; but their complete shape is most strikingly displayed by a combination of strong reflected and feebler transmitted rays of various degrees of obliquity. A tube of half an inch diameter, under a one-inch objective, presents nearly the entire field in focus, and the perfect crystals appear from one-half to three-quarters of an inch in diameter.

As regards the statement that arsenious acid sometimes assumes the cubic form, I would venture to suggest that Dr. Guy may possibly have been deceived by a hasty examination. An octahedron, if opaque and seen only by transmitted light, often appears a cube, since, when viewed perpendicularly to either axis, its section or outline is square. I may mention as a parallel case that I have obtained crystals of hydrate of calorine full a tenth of an inch in diameter which, for the most part, seemed to be perfect rhombs (the angles were 110° and 70°), but a closer observation convinced me that Faraday's description of them as "acute flattened octohedra with three unequal axes" (*i. e.* rhombic octahedra) was really correct. Such misapprehensions are very likely to occur under high magnifying powers.

I will describe an actual experiment which will show that my method is applicable to minute quantities as Dr. Guy's, while it is far more conclusive in its results. Dr. Guy states that a thousandth of a grain of arsenious acid yielded on sublimation a "circular mist consisting of brilliant detached points distributed evenly over the surface (of a disc) and easily resolved into octahedra under *an eighth* power of the microscope." By way of comparison I accurately weighed out a grain of pure arsenious acid on a balance sensible to the thousandth of a grain. I dissolved this in water, and make up to a known bulk. By means of a graduated pipette I took a thousandth part of this, containing of course a thousandth of a grain of arsenious acid, and evaporated it to dryness on a bit of curved glass. The latter, with the slight residue adhering to it, was then cut up and placed in a corked tube, four inches long by four-tenths of an inch in diameter. On igniting the fragments, a feeble sublimate appeared halfway up the tube, which, under a quarter-inch objective, was seen to consist of granules, evidently crystalline, but of indeterminable shape, and not more than one ten-thousandth of an inch in size. Re-sublimed by my method, these gave a few crystals, which were sought out by the inch objective, and then examined under the quarter-inch. They were beautifully perfect in shape, and about one twelve-hundredth of an inch in diameter. This alone would yield the strongest presumptive evidence of the nature of the substance in question, but I can by no means agree with one of the speakers at the meeting (Dr. Thudichum), who considered that we might afford to neglect applying the liquid tests to a solution of the sublimate. Each reaction must stand for what it is worth, but the concurrence of many furnishes proof the most irrefragable. The above quantity seems to be about the smallest that would yield any definite result in a tube of the size named; but unless much more than a thousandth of a grain of arsenious acid were obtained by Reinch's test, I, for one, should be extremely loath to assert that it had been criminally administered. Indeed I fear that the detection of this particular poison has reached an almost dangerous degree of delicacy, for we live surrounded by means of unconsciously absorbing traces of arsenic. We breathe arsenicated dust from the green flock papers on our walls; arsenical

papier mouré lies soaking on dishes afterwards used for culinary purposes; arsenic is contained in glazed green papers which are often employed for wrapping cocoa and other articles of food, and confectioners supply it wholesale in their cake ornaments. The very drugs prescribed for our relief, especially the compounds of bismuth, are tainted with arsenic, and it has even been detected in carbonate of soda. Nay more, even our vegetable food, as Professor Davy has lately pointed out, may be contaminated with arsenic derived from superphosphate manure, and there is probably no drinking water containing iron without a trace of arsenic as well. Now metals are remarkably prone to become localised in particular organs; the "dropped joints" of painters are found to contain lead permanently combined with the tissue, and a course of iodide of potassium will bring off abundance of mercury by the urine years after its administration. It would appear by no means improbable that traces of arsenic occasionally introduced into the system may be stored up in like manner (especially in the liver), till in the course of years the amount becomes appreciable. Many aquatic plants contain much iodine, all gradually absorbed from the water in which they live, though it cannot be detected therein from the minuteness of its quantity; the vegetable tissue, however, accumulates it and retains it persistently. So may it be with arsenic in the human body; and I think toxicologists should pause before affirming that it had been criminally administered unless a proportionate amount of the poison is found.

I am, &c. FREDERICK W. GRIFFIN, Ph. D.

Improvements in the Manufacture of Steel and Wrought Iron.

To the Editor of the CHEMICAL NEWS.

SIR,—I have observed in the CHEMICAL NEWS (p. 203) a notice of my patent for Improvements in the Manufacture of Steel and Wrought Iron, which ends with an inquiry respecting the breaking up of the metal on the floor of the refining chamber. To obviate this difficulty, which is the chief objection to the process, I give the floor of the chamber a sufficient inclination from the cone on which the melted iron strikes to prevent its accumulating in thick plates or lumps. Cast iron moulds similar to those now in use may also be conveniently used. The process is now being carried out at the works of the Pembrokeshire Coal and Iron Company, and I hope shortly to be able to bring some of the iron, which will be found to possess very great tenacity and closeness of grain, before the notice of the public.—I am, &c.

W. H. NEVILL.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

On Hyponiobic Fluorides.—H. Rose describes some of these combinations.[1] The hydrate of hyponiobic acid easily dissolves in fuming hydrofluoric acid at the ordinary temperature. When the solution is evaporated to dryness, hydrofluoric acid is first disengaged, and then by further heating white vapours of the fluoride: there remains the hyponiobic acid, which is yellow while hot, but becomes white on cooling. When it is attempted to distil hyponiobic with hydrofluoric acid, the former is not volatilised; but if some concentrated sulphuric acid is added to the mixture, vapours of the hyponiobic fluoride are produced at the ordinary temperature, which decompose in water. Hyponiobic fluoride, like the niobic, combines with metallic fluorides, but the combination of these double salts could not be obtained with the hydrofluates of fluoride of sodium and potassium.

The fluoride of hyponiobium and potassium is obtained either in a crystalline powder, in scales or in needles. Dried at 100° C. it dissolves in a small quantity of warm water, but the solution becomes turbid after some minutes, and can only be made clear by the addition of some dilute sulphuric acid. When the excess of sulphuric acid is driven off, the sulphate of potash can be separated from the hyponiobic acid by means of water. The salt contains $2\,K\,Fl + Nb\,Fl_3$.

The fluoride of hyponiobium and sodium appears to contain

$$Na\,Fl + Nb\,Fl,$$

mixed with some hydrofluate of fluoride of sodium and some fluoride of sodium.

II. ORGANIC CHEMISTRY.

Gases in Milk.—Hoppe[2] has published a long account of the ingredients of milk, to which we shall return on another occasion: the following analyses of the gases in that fluid we extract now. The milk was drawn and the examination was made with all possible precautions, but the results obtained were very different. The milks contained from 3·2 to 3·4 per cent. at 38°C. and the composition was as follows:

	I.	II.
Carbonic acid	9·00	55·15
Oxygen	9·57	4·29
Nitrogen	81·43	40·56
	100·00	100·00

On Two New Series of Acids.—When monochloracetate of soda is boiled with water, it is converted into chloride of sodium and glycolic acid. Heintz endeavoured to form lactic acid by treating monochloracetic acid with methylate of soda. The reaction indicated by theory took place, but the acid formed differed from both lactic and sarcolactic acids, although it possessed the same composition. Heintz has named it *methoxucetic acid.*

The reaction which takes place is as follows:—

Monochloracetic acid.	Methylate of soda.	Methoxacetate of soda.	Wood spirit.

$$\overbrace{C_4H_3ClO_4}+2\overbrace{C_2H_3NaO_2}=\overbrace{C_4H_3(C_2H_3)NaO_4}+\overbrace{C_4H_4O_2}+NaCl.$$

On evaporating the aqueous solution of methoxacetate of soda with some sulphate of zinc, and exhausting the residue with alcohol, methoxacetate of zinc is dissolved. This latter salt crystallises from the aqueous solution in large and beautiful crystals, which contain

$$C_6H_5O_5.ZnO + 2HO.$$

The solution of this salt decomposed by sulphuretted hydrogen, and submitted to distillation, gives at 198°C. methoxacetic acid in the form of a colourless acid liquid, with a smell like acetic acid. The author expresses the composition of the acid by the formula $\left.\begin{matrix}C_6H_5O_4\\H\end{matrix}\right\}O_2$.

Ethylate of soda acts violently on monochloracetic acid: the products of the reaction are chloride of sodium, and the soda salt of a new acid homologous with the last, which Heintz calls *ethoxacetic acid.* Its formula is $C_8H_8O_6$.

In the same way *amoxacetic* and *phenoxacetic acids* are formed by the action of *amylate* and *phenylate* of soda on monochloracetic acid.

When the soda salts of organic acids are heated with monochloracetic acid, chloride of sodium is formed, and new organic products which the author proposes to study.[3]

Combustibility of Tobacco.—Smokers know that there is a great difference in the combustibility of various tobaccos, but have not troubled themselves about the reason why. M. Schlœsing, chemist to the Imperial Tobacco Manufactory, has however occupied himself with the question, and has come to the following conclusions: 1. That the ashes of a combustible tobacco always contain carbonate of potash (tobacco never contains soda) in proportion to its combustibility. 2. That the ashes of an incombustible tobacco do not contain carbonate of potash. 3. That an incombustible tobacco may be made combustible if an organic salt, such as malate, citrate, oxalate or tartrate, be added to it. And 4. That a combustible tobacco may be made incombustible by adding to it a sulphate or chloride of calcium, magnesia, or ammonia. The carbonate of potash, however, cannot be the cause of the combustibility, inasmuch as it does not pre-exist in the plant but is a product of combustion. The cause must be

[1] *Pogg. Ann. der Phys. u. Chem.* Bd. cvIII. s. 465.

[2] *Chemisches Centralblatt*, No. IV. p. 60.

[3] *Monatsbericht d' Acad. der Wissenschaften zu Berlin*, Aug. 1859, p. 554.

looked for in the organic compounds of potash, the incineration of which furnishes the carbonate. In a future communication the author intends to give some information which will tend to improve the culture of tobacco.[4]

The Alcoholic Fermentation.—M. Pasteur[5] publishes the beginning of a long essay on the alcoholic fermentation, in which he shows that glycerine and succinic acid are constant products of the alcoholic fermentation, that the elements of these bodies are obtained from the sugar and not from the yeast: that glycerine, succinic acid, alcohol and carbonic acid, are not the only products; and that lactic acid is sometimes an accidental product. He then enters on the question what becomes of the yeast, and shows that the nitrogen of this body is never transformed into ammonia during the fermentation, and that when ammonia is added it disappears.

Houblonine.—A M. Ramont[6] has made a great discovery. He says that by making a decoction of hops in a close vessel, he has obtained an extract which he calls *houblonine*, and which he says contains all the active principles, aromatic, bitter, and astringent of the hop, by the help of which he expects to simplify the brewing of beer.

III. CHEMICAL ANALYSIS.

Removal of Arsenic from Sulphuric Acid.—Dr. Grüger[7] writes that arsenic is most easily removed from sulphuric acid by means of chloride of barium. Crystals of this salt should be added to the acid previously made hot.

[4] *Comptes-Rendus*, t. l. p. 60.
[5] *Ann. de Chim. et de Phys.* t. lviii. p. 323.
[6] *Cosmos*.
[7] *Dingler's Polytech. Journ.* Bd. clv. s. 236.

SCIENTIFIC NOTES AND QUERIES.

Determination of the Amount of Alcohol in Wines and other Alcoholic Mixtures.—SIR,—In reply to your correspondent in No. 16 of the CHEMICAL NEWS, p. 192, I beg leave to say that I did not "set out with the assertion that the result obtained in the working of the example is erroneous." What I said was that if the rule given in No. 3 were followed it must give a false result: and I must say so still; for the correct result is obtained by following, not the rule given at p. 36, but a different rule, this, viz. from the sum of unity + the sp. gr. of the wine subtract the sp. gr. of the fluid after evaporation and made up with water. In the formula given by me at p. 108, $s_2 = 1 - 2\Delta$ is the sp. gr. of a volume v of alcohol and water. When another volume v of water is added to this the sp. gr. of the volume 2v will be $\frac{1+s_2}{2} = 1 - \Delta = 1 + w_1 - w_2$; and it is according to this formula that the example in No. 3 is worked, and *not according to the rule given in words*. The example was worked by some one who knew how to depart from the rule. But there are others who simply follow a rule laid down; such persons would *necessarily* obtain a false result by following the rule given in No. 3. For ± ·0127 is the only possible difference between 1·0080 and 0·9953: by no operation direct or "reverse" can 0·9873 be the difference.—*E. C.*

Valuation of Stannate of Soda.—SIR,—Would any of your numerous correspondents be so kind as to favour me with a simple and expeditious method, by means of which the amount of soluble oxide of tin in commercial stannate of soda could be determined volumetrically.—*Chemicus.*

MISCELLANEOUS.

Liebig's Soup for Invalids.—Take half a pound of newly killed beef or fowl, chop it fine, add 1½lb. of distilled water, with four drops of pure muriatic acid, and 34 to 67 grains of common salt, and stir well together. After an hour the whole is to be thrown on a conical hair sieve, and the fluid allowed to flow through without any pressure. The first thick portions which pass through are to be returned to the sieve, until the fluid runs off quite clear. Half a pound of distilled water is to be poured in small portions at a time on the flesh residue in the sieve. There will be obtained in this way about a pound of fluid (cold extract of flesh), of a red colour, and having a pleasant taste of soup. The invalid is allowed to take it cold, a cupful at time at pleasure. It must not be heated, as it becomes muddy by heat, and deposits a thick coagulum of albumen and colouring matter of blood. In soup prepared in the usual way by boiling, all those constituents of flesh are wanting which are necessary for the formation of blood albumen; and the yolk of egg which is added is poor in those substances, for it contains in all 82½ per cent. of water and fat, and only 17½ per cent. of a substance the same or very similar to albumen of egg. But whether it is equal in its power of nutrition to the albumen of flesh, is at least doubtful from the experiments of Magendie. Besides the albumen of flesh, the new soup contains a certain quantity of colouring matter of blood, and with it a much larger quantity of the necessary iron for the formation of the blood corpuscles, and finally the muriatic acid to assist digestion. A great obstacle to the use of this soup in summer is its liability to change in warm weather. It enters into fermentation like sugar with yeast, but without acquiring a bad odour. What may be the substance which gives rise to this fermentation is a question well worthy of being investigated. The extraction of the flesh must consequently be made with very cold water, and in a cool place. Iced water, and external cooling with ice, completely remove this difficulty. But the most important point to be attended to, is to employ meat quite recently killed, and not several days old.

Adulteration in America.—Dr. Hiram Cox, the Cincinnati inspector, has published many deeply interesting facts of his experience in testing liquors sold in that city. In 700 inspections of stores and lots of liquors of every variety, he found that 90 per cent. were impregnated with the most pernicious and poisonous ingredients. Nineteen young men, all sons of respectable citizens, were killed outright by only three months drinking of these poisoned liquors. Many older men, who were only moderate drinkers, died within the same period of delirium tremens, brought on in one quarter the time usual, even with confirmed drunkards, by drinking this same poison. Of 400 insane patients, he found that two thirds had lost their reason from that cause. Many of them were boys under age. One boy of seventeen was made insane by the poison from being drunk only once. Seeing two men drinking in a grog shop, and that the whisky was so strong that it actually caused tears to flow from the eyes of one of them, the doctor obtained some of it and applied his tests. He found it to contain only 17 per cent. of alcohol, when it should have contained 40, and that the difference was supplied by sulphuric acid, red pepper, caustic potassa, and strychnine. A pint of this liquor contained enough poison to kill the strongest man. The man who had manufactured it had grown wealthy by producing it.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. C.—When a tincture is made with Egyptian and Turkey opium together, they should first be dissolved in boiling water, and the rectified spirit added when the solution is cold. The tincture can then be obtained bright. Generally a tincture made with Egyptian opium will not filter bright, but now and then a sample is met with which will.

B. G.—We do not think it necessary to teach our readers the rudiments of chemical analysis. There are several small works on analysis which you can buy. Fresenius or Noad is often to be met with cheap on London bookstalls.

W. D.—1. By the slow combustion of phosphorus (*See* CHEMICAL NEWS, No. 10.—2. 40 cells are required to show the light well.—3. The details of the process will be found in the specification of the patent.—4. Mix two equivalents of the ferrocyanide with 5 eq. of nitric acid diluted with an equal bulk of water. When dissolved, transfer the solution to a large flask and heat over a water-bath. When it gives only a dark green or slate coloured precipitate with ferrous salts, remove from the fire and leave the solution to crystallise. Separate the mother liquor, and neutralise with carbonate of potash. The liquid then contains only the nitro-prussiate and nitrate of potash. The nitrate crystallises out first, and the remaining liquid on further evaporation gives crystals of the nitro-prussiate.—5. Not inconvenient: but would require at first a little more thought.

Cymro.—1. We cannot.—2. Hassall's *Adulterations Detected*, &c.

W. G.—1. We do not know Susquehanna root. It is a mythical remedy of some country quacks.—2. We cannot answer the question.—3. *a* should be

$$4\,(KO\,ClO_5) + 12\,HCl = 4\,KCl + 12\,HO + 3\,ClO_4 + 9\,Cl\,;$$

and *b*

$$3\,(KO.ClO_5) + 2\,(HO\,SO_3) = 2\,(KO.SO_3) + 2\,HCl + KOClO_7 + 2\,ClO_4.$$

—4. The mercury ought not to separate, but it is rare to find a sample in which it does not.—5. Probably yes, if the vine disease should increase.

A College Chum.—It is probably a mixture of several things (the composition of which will depend upon the degree of purity of the original benzole), and some undecomposed nitro-benzole.

*** All *Editorial Communications* are to be addressed to Mr. CROOKES, and *Advertisements* and *Business* communications to the PUBLISHER, at the Office, 12 and 13 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Action of Chlorine and Iodine on the Oxide and Salts of Silver, by M. Alfred Naquet.[1]

1. Action of Chlorine on Nitrate of Silver.—The author passed chlorine into a solution of nitrate of silver until the liquid smelt strongly of that gas, and then filtered it through asbestos. The filtered liquor was coloured yellow by some free chlorine, and did not contain the least trace of silver, which was proved by testing with hydrochloric acid and sulphuretted hydrogen. It was now left in a vacuum for 20 hours, at the end of which time it had lost all colour and did not precipitate nitrate of silver, showing that the free chlorine had been removed. It smelt strongly of hypochlorous acid however, and decolorised indigo. As the absence of colour excluded the possibility of the presence of chlorous acid, that of hypochlorous acid could not be doubted.

It remained to be seen whether chloric, or even perchloric acid, was not produced at the same time. For that the author divided the liquid into two parts. The first was saturated with potash, then placed in a water bath, and a current of carbonic acid passed through it for several hours. At the end of the operation, the gas, which at first smelt strongly of hypochlorous acid after being passed through the liquor, had lost all odour. The liquid no longer bleached indigo; and as sulphurous acid did not restore the bleaching property, it was concluded that the liquid contained no trace of chlorate.

The second portion of the liquor was similarly treated with carbonic acid, then evaporated to dryness, and the residue calcined; this, redissolved in water, was not precipitated by nitrate of silver in the presence of nitric acid. The original solution, therefore, did not contain perchloric acid.

From this it appears that the action of chlorine on a solution of nitrate of silver, produces chloride of silver and free hypochlorous acid. Perhaps chloric acid would be formed if the solutions were more concentrated.

2. Action of Iodine on the Nitrate and Oxide of Silver.—The author first treated an excess of iodine with nitrate of silver in the cold. The insoluble deposit was separated by filtration from the solution, which was then digested with oxide of silver, and the precipitate now formed was added to the first. The united precipitates were then treated with alcohol, to remove the free iodine, and afterwards boiled with a solution of pure potash. After boiling a short time, the liquid was filtered. The filtrate was coloured blue by the simultaneous action of starch paste and sulphurous acid, but was not changed when chlorine was substituted for sulphurous acid. On being left to cool, it deposited a slightly soluble salt, which possessed the characters of iodate of potash, but which the author did not analyse.

[1] *Répert. de Chim.* 1860, p. 126.]

The deposit left after the action of the potash was formed of a mixture of oxide and iodide of silver, which were separated by means of weak nitric acid.

The first experiment went to prove that in the action of iodine on nitrate of silver (or, which comes to the same thing, on oxide of silver) iodic acid and iodide of silver are produced. Nevertheless, as the presence of iodic acid was only revealed by boiling with potash, it might be supposed that a less oxygenated compound of iodine was first formed which was decomposed by the reagent. The author, therefore, recommenced his experiments as follows: —

He first heated a mixture of iodine and oxide of silver mixed with water, to boiling, these two bodies having but a feeble action on each other in the cold. When the reaction was finished the solution was filtered. The filtrate was acid, and coloured yellow by free iodine, which the excess of acid prevented from colouring starch blue. This colouration took place on the addition of sulphurous acid, but not on the addition of chlorine. Another portion of the filtrate evaporated in a vacuum, left a white hygrometric mass which possessed all the reactions of iodic acid.

If the first experiments were correct, the precipitate ought to contain iodate of silver. Fearing that in the former case the iodic acid might have been formed by the action of the potash on some iodine which had escaped the alcohol, another proceeding was adopted. The author boiled the precipitate with an aqueous solution of iodide of potassium, and then found, by means of sulphurous acid and starch, that the filtered solution contained an iodate.

By the action of iodine on oxide of silver, there is formed, then, iodide of silver and iodic acid. If the oxide is in excess, all the acid is in the form of iodate of silver; if, on the contrary, iodine is in excess, a part of the acid is found free, while the rest is combined with the oxide of silver.

To account for the production of free iodic acid, the author treated iodate of silver with iodine, and found that under these circumstances iodic acid was set free.

Some phenomena which the author observed led him to examine the action of nitric acid with four equivalents of water on the iodide and iodate of silver, and on a mixture of these two salts, as well as that of potash on the two first, and he discovered:

1. That iodide of silver is decomposed by boiling nitric acid, with the formation of nitrate of silver and the disengagement of iodine;

2. That the mixture of the iodide with the iodate, neither facilitates nor hinders the decomposition;

3. That the iodate of silver dissolves in boiling nitric acid without alteration;

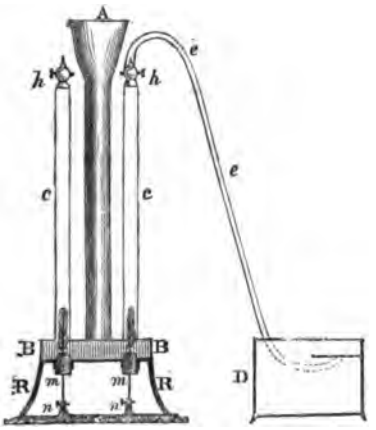
4. That caustic potash quickly decomposes iodate of silver even in the cold, forming iodate of potash and oxide of silver;

5. That iodide of silver is not acted on by potash in the cold, and only very slightly when the two are heated together.

On the Construction of a New Electrolytic Apparatus, by J. J. Coleman, *Lecturer on Chemical and Physical Science, Commercial College, Making Place, Halifax.*

Notwithstanding the numerous forms of apparatus already contrived for the purpose of decomposing water, by the agency of a voltaic current, the collection of the gases separately, and in sufficient quantity for experimental demonstration, is yet a rather troublesome operation. These considerations have induced the author to construct an instrument, the use of which is free from many objections attending the employment of the apparatus in common use, and as it has worked very satisfactorily, it is thought that the details of its construction may be deemed interesting to those concerned in this particular department of experimental science.

A simple inspection of the diagram will suffice to show the principle upon which the apparatus is constructed.



B B represents a closed chamber of glass; from its upper surface proceed three glass tubes. Two marked c c are of equal dimensions, and their upper apertures are furnished with stopcocks and jets, *h h*.

The other tube marked *a* is placed a little behind the two marked *c*, it is considerably wider, and is furnished with a funnel-like opening at the top. In the under plate of the closed chamber are two apertures *m m*, exactly beneath the tubes *c c*. These are furnished with corks, through which pass the electrodes, the conducting wire being attached to the battery by means of the binding screws *n n*. R R is a support for the whole.

In order to make use of the apparatus, water, acidulated with dilute acid, is poured into A (the stopcocks *h h* being open), until the tubes *c c* are exactly filled. The stopcocks being now turned, and connexion made with the battery, decomposition will take place, the evolved gases collecting in the tubes *c c*, an equivalent bulk of water being forced back into A.

If the apparatus is used for lecture demonstration, the hydrogen can be ignited and burnt at the jet without any trouble, and the usual test applied to the oxygen. The effect of lessening the size of the positive electrode is capable of being shown in a very interesting manner, as the ozone can be detected with the utmost ease by merely holding test paper over the jet as the gas escapes.

On the other hand, if it be desirable to transfer the gases to other vessels, the conducting tube *e* must be attached to the stopcock by means of a connector; the stopcock is opened, and dilute acid poured into A until the tube *e*, as well as *c*, are completely filled; the stopcock is then turned. When the gas has collected in *c*, it will only be necessary to open the stopcock and fill up A with water or dilute acid, and the gas will at once be transferred to the receiver in the pneumatic trough.

In the ordinary form of apparatus, the wetting of the hands with dilute acid cannot be avoided, which, to say the least, is not by any means pleasant, but, it will be observed, that with this instrument no such necessity occurs. Again, the little trouble required in its management, the ease with which the electrodes can be removed, altered, or replaced, the perfect control the manipulator has over the products, in whatever quantity they may be liberated, must be very obvious. Not only is it valuable for lecture demonstration, but also for volumetric determinations; the gases can be transferred by the method already detailed with the utmost accuracy. Finally, the instrument is well adapted for other electrolytic experiments than the decomposition of water, as the electrodes can easily be replaced or examined, and any gas evolved collected for experiment with the utmost ease.

A very interesting modification of the above apparatus can be constructed by substituting for the two tubes *c c* a single Volta's eudiometer, so as to enclose both electrodes; the mixed gases would then be collected ready for detonation; but, unless a stopcock were attached to the upper end of the eudiometer, the instrument would be rather awkward to fill.

PHARMACY, TOXICOLOGY, &c.

On some of the Chemical Re-actions of Strychnia, by T. G. Wormley, *M.D.*

(*Continued from page* 219.)

8. Bichloride of Platinum.—1. $\frac{1}{100}$, an immediate yellow amorphous ppt., soon becoming granular.

2. $\frac{1}{500}$, in a few moments an amorphous ppt., which soon becomes granular.

3. $\frac{1}{1000}$, in a few minutes the results are very good.

4. $\frac{1}{5000}$, if the solution be rubbed, small granules begin to appear in a few minutes, and soon the result is satisfactory.

9. Terchloride of Gold.—1. $\frac{1}{1000}$, gives a bright yellow amorphous ppt., which soon becomes partly granular; most of the granules float upon the surface of the drop. A portion of the ppt. collects into little yellow flakes.

2. $\frac{1}{5000}$, gives an almost immediate precipitate.

3. $\frac{1}{10000}$, gives very satisfactory results.

4. $\frac{1}{50000}$, at this degree of dilution the ppt. is still perceptible, but not satisfactory.

When the ppt. obtained from a solution containing $\frac{1}{1000}$ or less of its weight of strychnia is boiled, the ppt. will dissolve and give a yellow solution, from which it will again be deposited with little or no change upon becoming cool. If the solution contains more than $\frac{1}{1000}$ its weight, the ppt. will not entirely dissolve upon boiling; after cooling there will generally be a metallic gilding upon the sides of the tube. The ppt. produced from $\frac{1}{5000}$, or more dilute solutions will readily dissolve, without change of colour, upon the addition of a drop or two of potash solution; if then the solution be boiled it will become a fine purple colour, with sometimes a purple ppt. When the ppt. is from a stronger solution than above stated, it does not readily dissolve in potash, and when the mixture is boiled it yields a fine purple solution, with more or less of purple precipitate.

10. Chromate of Potash (Yellow).—1. $\frac{1}{100}$ gives an immediate yellow mass of crystals, soluble in 30 drops of strong acetic acid.

2. $\frac{1}{1000}$, begins to form in a few seconds, but they are not very abundant after standing 15 minutes.

3. $\frac{1}{5000}$, with the microscope a few prisms may be observed in 8 minutes, but to the naked eye no indication after 20 minutes.

11. Bichromate of Potash.—1. $\frac{1}{100}$, an immediate mass of brilliant yellow dendroidal crystals.

2. $\frac{1}{1000}$, in a few seconds much the same as 1.

3. $\frac{1}{5000}$, crystals began to form in a few seconds, in a few minutes they are abundant.

4. $\frac{1}{10000}$, in a few minutes beautiful octahedra appear, resembling those of oxalate of lime.

5. $\frac{1}{15000}$, by rubbing, the crystals are obvious with the microscope in a few minutes, and in several they can readily be seen with the eye.

The precipitate produced by this reagent is not so readily soluble in acetic acid, as that produced by the yellow chromate of potash.

12. Carbazotic Acid.—This, and the three following tests, we have formerly recommended in our lectures. The only specific account we have seen of any of them, is in the recent edition of Taylor *On Poisons*, in which the iodine test is suggested.

An alcoholic solution of carbazotic acid will produce with—

1. $\frac{1}{150}$ grain of strychnia an immediate yellow amorphous ppt., soon becoming tufts of a twig-like form.

2. $\frac{1}{1000}$, almost immediately a ppt., soon becoming same as 1.

3. $\frac{1}{5000}$, by rubbing a few seconds, a copious deposit of granules.

4. $\frac{1}{10000}$, in about a minute much the same as 3.

5. $\frac{1}{20000}$, in a few minutes small granules are very obvious.

13. Chloride of Palladium.—1. $\frac{1}{100}$, an immediate dirty white ppt., soluble in acetic acid, insoluble by boiling.

2. $\frac{1}{1000}$, an immediate yellow precipitate.

3. $\frac{1}{5000}$, in a few seconds the ppt. is perceptible, and soon becomes pretty good.

4. $\frac{1}{10000}$, after rubbing for several minutes a few granules can be observed with the microscope.

14. Iodine.—Of the various tests recommended for strychnia, this is the most delicate. It was applied in the following experiments, by dissolving three grains of iodide of potassium in one fluid drachm of water, and then adding one grain of iodine.

1. $\frac{1}{1000}$, immediately a copious brownish yellow amorphous ppt., soluble in alcohol and ether, but only soluble in large excess of acetic acid. The ppt. partially dissolves in a few drops of potash solution, but is immediately replaced by a dirty white precipitate.

2. $\frac{1}{5000}$, a yellowish ppt., soluble in potash, and replaced by a dirty white precipitate.

3. $\frac{1}{10000}$, the precipitate dissolved in potash gives a faint white precipitate.

4. $\frac{1}{15000}$, the ppt. is immediately produced, and soon collects into little yellow flakes.

5. $\frac{1}{20000}$, if the drop be touched with a small drop of the reagent upon the end of a glass rod, it gives immediately a very obvious yellow precipitate.

If a few drops of the last named solution be placed in a watch glass, and a drop of the test fluid be placed by its side and allowed to flow into the solution, as they meet yellow streaks can readily be observed, and the solution will become turbid.

15. Bromine.—This reagent was prepared by saturating a strong solution of hydrobromic acid with bromine.

1. $\frac{1}{1000}$, gives an immediate bright yellow amorphous ppt.

2. $\frac{1}{10000}$, a greenish yellow precipitate.

3. $\frac{1}{15000}$, a dirty yellow ppt., which after a time nearly all dissolves.

4. $\frac{1}{20000}$, the ppt. is perceptible, but soon dissolves.

16. Colour Test.—It is well known that if strychnia, or its salts, be dissolved in sulphuric acid, and then a small quantity of bichromate of potash, ferridcyanide of potassium, peroxide of lead, or of peroxide of manganese, be added, a series of colours are developed. This is known by the name of the colour test. We have succeeded best by placing the strychnia, or a drop of the solution evaporated to dryness, in a watch glass, and by its side a drop of strong sulphuric acid, into which a fragment of bichromate of potash was introduced, and stirred until it imparted a yellow colour; then by inclining the watch glass the coloured sulphuric acid was allowed to flow over the strychnia.

1. $\frac{1}{1000}$ grain of strychnia in one drop of water, gave in a majority of a number of experiments very satisfactory results, however, in some the reactions were just perceptible. In solutions stronger than the above the results were always very satisfactory.

2. $\frac{1}{2000}$, in many cases we failed to get any indication, in others there was a faint trace of colour, which very rapidly disappeared. In no instance was there such a reaction as should be sufficient for medico-legal purposes.

3. $\frac{1}{1000}$ of a grain, dry, will always give a fine reaction; by allowing the acid to flow upon a portion of the deposit at a time, several indications may be obtained from the same deposit.

4. $\frac{1}{2000}$, dry, in a majority of instances the results were very good; in some, however, they were very faint. The success of the experiment depends much on the character of the deposit left by evaporating the solution to dryness; sometimes the principal part of it is in the form of a ring, which, when examined with the microscope, consists of well-defined crystals; at others, the deposit is a confused mass distributed over the space occupied by the drop. In the latter case the result will not be nearly so satisfactory as in the former.

5. $\frac{1}{3000}$, in a number of cases manipulated differently, the majority gave no indication; some few a slight trace, but in no instance was the reaction satisfactory.

As the colour test is relied upon, perhaps, more than any other for medico-legal purposes, it is important to remember that it is interfered with by the presence of morphia. When *one part of strychnia* is mixed with—

1. One part of morphia, it gives very good results. The colours, however, are not so bright as with strychnia alone.

2. 1½ of morphia. If a small quantity of this mixture is used the reaction is very good, but in a larger quantity the reaction is just perceptible.

3. 2 of morphia. A small quantity of this mixture will give a pretty good reaction; $\frac{1}{50}$th grain gives but a mere trace.

4. 3 of morphia. A very small quantity of this mixture will give but little indication, and a larger quantity gives no reaction indicative of the presence of strychnia.

17. Physiological Test.—We are indebted to Marshall Hall for this test. It consists in administering strychnia to frogs, by which they are rendered violently tetanic; he recommended the frogs to be placed in a solution of the poison. Dr. Harley proposes to inject

the liquid into the thoracic or abdominal cavity of the frog.

In the following experiments a small portion of the strychnia solution—from 1¼ to 2 grains of fluid—was taken up by a pipette, the end of which was then introduced into the stomach of the animal, and the solution dislodged by blowing through the tube. The frogs were then placed under an open glass receiver. The species used was the *Rana Halecina.—Kalm.* From experiments made upon more than one hundred individuals, we are led to believe that this species is more sensitive to the effects of strychnia than any of the other several species found in this locality; however the difference observed may have been due to some other cause than difference of species. The weight of the frogs used in the experiments detailed below, varied from 18 to 45 grains.

1. When a solution holding $\frac{1}{100}$th its weight of strychnia was used, the animals immediately became rigid, with violent tetanic spasms, and died, on an average, in 8 minutes.

2. When a $\frac{1}{1000}$ solution was used, the symptoms usually began in about three or four minutes.

3. $\frac{1}{5000}$ solution: the symptoms appeared in some in ten minutes, in others they were delayed as long as 24 minutes.

4. $\frac{1}{10000}$th solution; of 22 frogs used, in 17 of them the symptoms appeared in from 27 to 45 minutes; in the other five there were no unequivocal symptoms; there was, however, very great prostration, and some slight tetanic movements.

5. $\frac{1}{20000}$th solution; of 10 small individuals used, eight were seized in 45 minutes, the others did not show unequivocal tetanic spasms.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, *Thursday*, 19 *April* 1860.

R. Warrington, *Esq. in the Chair.*

Messrs. M. J. Stark, J. A. R. Newlands, J. McDonnell, C. E. Long, and F. Sutton were elected fellows.

Messrs. Perkin and Duppa read a paper *On the Artificial Production of Tartaric Acid.* The authors first attempted to procure bibromosuccinic acid by acting on succinic acid with bromine. This method proving unsatisfactory, they acted upon the chloride of succinyl with bromine, in sealed tubes heated to 120–30° C., whereby they procured the chloride of bibromosuccinyle, which by decomposition with water yielded bibromosuccinic acid, which acid after purification was analysed. It is a crystalline body, scarcely soluble in cold, readily soluble in hot water, very soluble in alcohol, still more so in ether. It is decomposed by heat, with production of hydrobromic acid. It is a bibasic acid, forming acid and neutral salts, several of which were examined. The neutral bibromosuccinate of silver when boiled with water underwent decomposition, with formation of bromide of silver. On filtering off the liquid and separating the small quantity of silver it contained by hydrochloric acid, refiltering, and evaporating to a syrup, which was placed *in vacuo* over oil of vitriol, crystals were formed, which by analysis and properties proved to be tartaric acid. The reaction was:

$$C_8H_2Br_2Ag_2O_8 + 2H_2O_2 = C_8H_6O_{12} + 2AgBr.$$

During the conversion of the bibromosuccinic acid, carbonic acid was constantly evolved, and a syrupy acid produced. This the authors believed to be pyruvic acid formed from tartaric acid by the loss of carbonic acid and water. Dr. Odling made some observations on the important services Messrs. Perkin and Duppa had rendered in this and their former papers, in extending and filling up the series of organic compounds consisting of carbon, hydrogen, and oxygen only, and drew on the black board tables of the acetic, propionic, and butyric families, thus:

C_2H_6O Alcohol.	C_2H_4O Aldehyd.	C_2H_2O
$C_2H_6O_2$ Glycol.	$C_2H_4O_2$ Acetic Acid.	$C_2H_2O_2$
	$C_2H_4O_3$ Glycolic Acid.	$C_2H_2O_3$ β Glyocylic Acid.
	$C_2H_4O_4$ α Glyoxylic Acid.	$C_2H_2O_4$ Oxalic Acid.
C_3H_8O Propylic Alcohol.	C_3H_6O Propionic Aldehyd.	C_3H_4O
$C_3H_8O_2$ Propylic Glycol.	$C_3H_6O_2$ Propionic Acid.	$C_3H_4O_2$
$C_3H_8O_3$ Glycerine.	$C_3H_6O_3$ Lactic Acid.	$C_3H_4O_3$ Pyruvic Acid.
	$C_3H_6O_4$ Glyceric Acid.	$C_3H_4O_4$ Malonic Acid.
		$C_3H_4O_5$ Tartronic Acid.
$C_4H_{10}O$ Butylic Alcohol.	C_4H_8O Butylic Aldehyd.	C_4H_6O
$C_4H_{10}O_2$ Butylic Glycol.	$C_4H_8O_2$ Butylic Acid.	$C_4H_6O_2$
	$C_4H_8O_3$ Butyrolactic Acid.	$C_4H_6O_3$
		$C_4H_6O_4$ Succinic Acid.
		$C_4H_6O_5$ Malic Acid.
		$C_4H_6O_6$ Tartaric Acid.

He also drew the following table showing the analogies subsisting between the succinic class of acids and the phosphoric acids.

$PH_3O_4 - H_2O = PHO_3$	
Phosphoric.	Metaphosphoric.
$C_4H_6O_4 - H_2O = C_4H_4O_3$	
Succinic.	Metasuccinic.
$C_4H_6O_5 - H_2O = C_4H_4O_4$	
Malic.	Maleic or Fumaric.
$C_4H_6O_6 - H_2O = C_4H_4O_5$	
Tartaric.	Meta-tartaric, or Tartaric-anhydride.

In the case of the metamalic and metatartric acids, there is no alteration of basicity; in the case of the metaphosphoric acid there is a difference which, however, may be only accidental, dependent upon the circumstance that phosphoric acid by losing an atom of water leaves only one atom of hydrogen, and consequently more than one atom of hydrogen cannot be replaced.

Mr. C. E. Long read a paper *On Crystallised Potassium and Sodium.* A piece of combustion tube, sealed at one end, and contracted in the middle, had introduced into the contracted portion a small funnel, resting only by its rim, and containing a wire gauze filter. After filling the tube with purified coal gas, lumps of thoroughly cleaned alkali metal were introduced into the upper part of the tube which, after continuing the supply of coal gas for some time longer

was ultimately sealed by the blowpipe. The metal was then partly melted, so as to expose a fresh surface to absorb any oxygen the tube might contain. After two or three days it was again melted and filtered through the gauge into the lower part of the tube which, by means of the blowpipe, was next separated at its contracted portion from the upper part of the tube containing the dross. The bright metal contained in the sealed tube was then melted and crystallised by suddenly pouring off during cooling the more liquid portions. The specimens have kept perfectly bright for eighteen months. Sodium has a most beautiful rose colour. It crystallises in quadratic octahedra, having apex angles of 50°. Potassium has a greenish blue colour, and crystallises in quadratic octahedra, havidg apex angles of 52°, and base angles of 76°.

Mr. D. Howard read a paper *On the History of Cinnamic Acid*. He found that crude cinnamic acid obtained from liquid storax contained a considerable proportion of cinnamic acid. By submitting purified cinnamic acid to distillation an oily product was obtained together with a small quantity only of unaltered cinnamic acid. The liquid product proved to be cinnamol, $C_{16}H_8$, boiling at 145° C. readily yielding the crystalline bibromide of cinnamol, being converted, at 200° C. into a glassy mass of metacinnamol, which at an increased temperature was reconverted into cinnamol. The cinnamol prepared from the distillation of cinnamic acid with excess of lime is perfectly free from benzol, but it contains a small quantity of a crystalline substance which proved to be identical in composition and properties with a compound named stilbene, obtained by Laurent from the destructive distillation of hydride of sulpho-benzoyl, $C_{14}H_6S_2$. Stilbene fuses at 125° C. and forms a crystalline bibromide, $C_{28}H_{12}Br_2$.

Messrs. Wanklyn and Buckheisen read a paper *On the Action of Sodium upon Iodide of Methyl*. Since sodium-methyl cannot be prepared by acting with sodium upon iodide of methyl, it was determined to examine the reaction to see whether methyl gas, which has never yet been obtained pure, could be prepared by this process. Iodide of methyl, ether, and sodium were heated together in sealed tubes to 100° C. The resulting gas after washing with water proved to have the following composition:—

C_4H_4 9·3 N 2·4 C_2H_4 65·0 C_2H_5 23·3

The next meeting of the Society will take place on Thursday, 3 May, when Dr. Gladstone will deliver a discourse *On Circular Polarisation*.

SOUTH KENSINGTON MUSEUM, 10 *April* 1860.

Lecture I. *On the Animal Products in the Museum, by* Ed. Lankester, *M.D., F.R.S.*

In pursuance of the object that I had in view on a former occasion when delivering a course of lectures on food, I come before you to night for the purpose of delivering a short course of lectures on the animal products used in the arts and manufactures. You are, perhaps, most of you acquainted with the fact that this museum is a representative of two departments which the Government of the country maintains for the purpose of the education of the great mass of the people of this country. It is called the Science and Art Department. With the Art Department I have little or nothing to do, and would merely here commend it to your earnest attention, and speak of it in terms of equal praise with the Department of Science, to which I am more immediately attached. Standing between our Art Museum and our Science Museum there is an additional museum, which has more particularly in view the teaching of the elements of the various branches of knowledge which are brought before the young. It is to this science collection which I wish more particularly to call your attention, and I would just say, in order that you may understand the position in which it stands in relation to the other collection, that it is only one part of a great whole. We collect together specimens of natural objects, as distinguished from objects of art, with which man's hand and mind have had much to do. With regard to the natural objects, they may be arranged together in a variety of ways, such as the natural history collection, a collection of all the varied forms of minerals, and also a collection of plants and of animals, as in the British Museum. They are there intended to illustrate, as it were, the varied forms of material objects which we find in the external world; in this museum, however, there is no attempt to illustrate so extensive an object, but the object kept in view is the illustration of the particular uses of minerals, of plants, and of animals; and, recently, within the last few years, there has arisen in this country and others a series of museums to illustrate the uses of external objects to man. It has been found that man's advancement upon the earth is entirely due to the way in which he uses these particular things, so as to apply them to his own wants. Hence we have economic or trade museums, representing, first, the raw materials of the mineral, vegetable, and animal kingdom, and then representing them in their manufactured condition, and passing through the various processes of their manufacture. Our own and other European governments have recognised the importance of these museums; thus we have in Jermyn Street a museum which contemplates not only exemplifying the geological history of Great Britain, but representing the various objects of the mineral kingdom used in the arts and manufactures. Then there are the great Botanical Gardens at Kew, where we find not only plants, but a large collection of the raw materials used by man for the various operations of the arts, and, to some extent, there is an attempt to represent there the manufacturing processes. In this institution we have the animal kingdom treated in the same way; we have a great collection of animal products which are used in the arts, and we have also collected specimens to illustrate the various processes which the raw materials undergo before they become fit for the use of man. It is my intention to show you what is the nature of the animal substances exhibited here, and what are the processes through which these substances pass before they are fit to be used by man for the various purposes of life.

But there is another view of the external world, to which I would draw your attention this evening, to show you the way we include the large department of which I have treated in the various courses of lectures. The external world supplies man with things which are not merely taken and used by him to supply an artificial want, such as wearing clothes, living in houses, and dining off plates, drinking tea out of cups and saucers, &c. but the world supplies him with things which he *must* take in common with the whole animal kingdom. There is the salt in the water and the various other saline substances which we eat; those are portions of the mineral kingdom which supply our natural wants. Then there are the materials of the vegetable kingdom, potatoes, cabbages, oats, wheat, rye, and other things which supply our wants in the vegetable kingdom. Then we take the animal, we roast and eat it, and in this way the animal kingdom supplies our wants, and I want you to see the parallelism. On the one hand nature supplies us with the food we take from day to day, as illustrated in our great museum. On the other hand, man is an artificial animal, dressing and using a variety of things sometimes from the vegetable, and sometimes from the animal kingdom, and it is the latter portion to which I wish to draw your attention in this and the ensuing lectures of this course.

Now I would just say a word or two with regard to those things. You see it is when man gets to know the properties of the materials of the external world that he uses these things. I do not know whether I can do better than illustrate it with the things I have before me. Who would think these little cocoons could ever be manufactured by man's ingenuity into the most highly prized articles of dress, giving a more pleasing and sightly appearance to the human form than any other substance? Thousands of our fellow-countrymen and countrywomen are employed upon and de-

pend entirely upon the employment to be derived from these little cocoons. Who would have thought all this would have depended, from the earliest times, upon the knowledge of the way to unwind the silk, to spin it, and to weave it? And then man having done this by his knowledge he is enabled to take a variety of substances from the mineral, the animal, and the vegetable kingdom, and stain the woven silk and give it a variety of colours, and so whilst he increases the beauty of the articles he increases the desire and the demand for them, and as man's intellect is employed in this occupation we may say it is by the intelligence of man as it is exhibited in the various manufactured articles that his civilisation may be indicated. You know when you go into a community of well dressed, well cared for people, that they are civilised, and what does that depend upon? It is not the ignorant man that is civilised; it is not the lazy man that is civilised. It can only occur in an intelligent, in an active and industrious community that you can find a civilised population—that civilisation can occur—and that gives us the greater encouragement to continue the study of these things. I want them to be studied a little more satisfactorily than they have been; it may be a little strange, but I believe my course of lectures here was the first attempt to systematise this study.

Before proceeding any further, I would just draw your attention to the distinction between animal and vegetable manufactures. It is curious that there should be so great a difference between the materials we employ from the animal and from the vegetable kingdom, and I will draw attention to the fact that the two sets of bodies are composed of different substances represented by the great primary materials of which plants and animals are more or less composed. Thus we find in plants, whether they are composed of vascular tissues, or of cells of this kind of form, that the greater part is composed of a hard substance called cellulose, or wood when it is formed into trunks and branches of trees. Now when we deal with the vegetable kingdom in our manufactures, we deal with this cellulose. When we deal with trees and cut them into boards, or when we take these delicate fibres and convert them into pocket-handkerchiefs and things of that sort, we deal with cellulose; and when we have worn all our cotton and our linen to rags, they are collected for the purposes of the paper-maker. The whole country is at this moment convulsed to know what we are to do for rags now we are going to take the duty off paper. There is an immense quantity of this cellulose in different parts of the world, in the forests of Asia, Africa, and America, and plenty in our own wildernesses, and it is only a question as to whether a man shall wear it first upon his back, or have it manufactured into paper at once. I believe the reduction of the paper duty will give the greatest incentive to the young chemists to pursue the subject and to make such discoveries and improvements in the art of paper-making, that the paper-manufacturer will be enabled to snap his fingers at rags. But when we examine the animal kingdom, we do not find any cellulose worth mentioning. Silk worms do not form it, nor is it to be found in the horns of cattle nor the hairs of animals, nor the feathers of birds, nor in any of the animal products used in the manufactures. We find there another thing called gelatine, or the substance used in making gelatine, always having the form of cells, but never having the properties of cellulose. Gelatine is soluble in hot water, while cellulose is not. Gelatine is known by its specific gravity being greater. Animal substances fall in water, but vegetable substances swim. Cellulose conducts heat with greater facility than gelatine, thus we are warmer in gelatine clothing than in cellulose. Animal substances are stronger. These, then, are some of the distinguishing features between substances that are manufactured from the vegetable kingdom and those which are manufactured from the animal kingdom. The artizan, the person who is working in these things, will do well to remember these facts, because out of some of them may arise important conclusions. Some of these dyes will not be taken up by the vegetable fabric. The dyes for cotton are not the dyes for the woollen or silk goods, and thus out of these matters arise the general facts with regard to animal and vegetable substances. Now looking at the animal kingdom, we see first that it supplies man with food, but we have nothing to do with that upon the present occasion. There is another application of animals with regard to civilised life. We use their strength or force. A man can lift a certain weight, and accordingly so many men equal a horse power, and so many horses make a steam engine power. This is a kind of muscular power which we constantly employ with horses, &c. in this country. That, however, is not what I want to treat of here, but the way in which their products are applied to the use of man. Take silk. Well, silk is woven into garments in a variety of ways, and used for purposes of textile fabrics. Then just as we use the solid portions of minerals and plants, so we use the solid portions of the animal, but, as the animal is more scarce, we do not use it for the same purposes; for instance, we do not build our houses with the animal kingdom; but there are certain portions of an animal, for instance, the skeleton, the bones, the horn, the hoof, the teeth, and a variety of other portions of animals, which are constantly used by manufacturers. Then, again, we find that the chemistry of the animal is of a different kind than the chemistry of the vegetable. You know that man is but a poor chemist in his laboratory as compared with a plant. Take a blade of wheat, exposed to the action of carbonic acid gas and ammonia; that little plant takes those elements in the most wonderful manner possible, and converts them to its own use in its laboratory, and lo! there is the cellulose, the oil, the starch, and the saccharine matter, and those little plants are doing this in every moment of our existence; whether we may be sleeping or waking, the laboratory of the plant is still employed for the use of man; the vegetable thus exercises an influence on the animal kingdom. The animal takes up the starch, and the sugar, the oil, the albumen, the fibrine, and the caseine, out of the plants, and then loosens the chemical affinities. An animal is more easily decomposed than a vegetable. If you doubt that, throw a log of wood and a dog into a stagnant pool; the dog, in a very few days, will become in such a state that you would not like to come near him, while the wood goes on for years and years before it becomes decomposed. But sometimes we arrest the change. There are these skins. We introduce tannic acid during their change, and they become leather. And there is the fatty matters of which we make soap. We take them while the chemical change is going on, and we employ them and turn them to a hundred uses in a variety of ways. Then there are certain things in the animal kingdom which come to us in the form of a disagreeable essence; there is the Muscovy cat, with its stinking scent, and we catch the animal, and import 10,000 ounces every year of that civet which we dislike so much; and then there is the musk ox and the deer, and ambergris, and other things which are used for perfumes. Then there are those dyes the cochineal and the lac insects yield. Then there are certain waste substances of animals, the Prussian blue, the purple, and the red, which we obtain from animal substances. Then there is a great quantity of things which are habitually thrown away as refuse. There are people who make buttons from bones and from the hoofs of cattle. When we come to study these things, we shall find that God has made no waste in the world at all. There is a maxim, "Waste not, want not," and we have wasted, and do waste, and in my last lecture of the present course I shall call attention to the waste in many things—in money thrown away in objects and in books.

Now to-night I will take up the subject of silk. You will see if you look at the whole animal kingdom how very few conquests man has made among the lower animals. Among the invertebrate animals—those animals without back bones—there are many that are useful to man. Sponge is an animal of the invertebrate group, and there is a variety of shell-fish yielding us mother-of-pearl. Then we come to

the various forms of articulate animals—crabs and lobsters; the bee yielding honey; the blistering fly yielding its secretion, which is valuable to man, under certain circumstances, and the leech, which is an article of trade among us. But I cannot say of all animals of the higher class that every part of them is at present useful. For instance, there is the hippopotamus: we cannot use every part of him; of his skin we could make leather, or we might boil him down and make him into jelly and eat him after dinner. But it is the insect tribe to which I wish to draw your attention to-night more particularly, in order to bring before you one of the most important of our arts and manufactures. This is the silkworm. Now, among the insects, of which you see a variety here, there are some that undergo changes of a remarkable kind, and some that undergo no change at all. Some produce eggs which produce creatures very much like their parents, while others produce creatures which are utterly unlike their parents. Take for instance the creatures to which the common moths and butterflies change. These lay eggs which produce larvæ which produce insects unlike their parents, who at last spin for themselves this grave or cocoon, and produce a thing which we call a chrysalis, where it lies for weeks, months, and sometimes even years; but at last the chrysalis bursts, and out comes the perfect insect — the butterfly or moth; and it is to these families that our silkworm belongs, to a family known to naturalists as the family of *bombycidæ*. This family has the habit of producing caterpillars which spin these kinds of cocoons or nests formed of a fibre which we know by the name of silk. It is not every species, however, of this family of *bombycidæ* from which we can obtain silk, although there are a large quantity of them that yield silk and fibre just in the same way as our common silkworm.

I have here a large number of specimens of silk obtained from other species of moth besides our common silkworm moth. That is an important point to recollect, for circumstances may occur by which we may obtain as large a supply as from the silkworm. There are difficulties in preserving the common silkworm moth, and if we could raise a coarse kind of moth for this purpose we should do the community a service. The more knowledge which those persons have who are engaged with these things, the more likely are they to make discoveries and introduce new sorts and kinds, and thus increase this serviceable produce. It has not been by ignorance or accident that man has discovered these things, but just as man has searched into nature he has been rewarded by discoveries, and if we expect to progress we must cultivate our minds, and bring them to bear on the practical arts of life. You see what splendid specimens of these creatures we have before us. Here is the *bombyx mori*, which produces all this silk and gives employment to a million of people in this country, and to millions in other parts of the world. And here is another moth having a peculiar mark on its wings. This moth deposits its eggs in the autumn, and these will hatch the next spring. Here is a bottle full of these eggs; they form little worms of this kind, which remain for six or eight weeks in this condition, increasing in size and eating more and more, until at last they become an exceedingly rapacious crew, devouring large quantities of the leaves upon which they live. They shed their skin four or five times before they begin to make the cocoon. Now this moth is called the *bombyx mori* because it feeds on the mulberry. There are two species of mulberry on which they are principally fed, the *morus alba* and the *morus nigra*. The *morus nigra* is the one that has been cultivated in Great Britain.

Unfortunately for us the silkworm always chooses to be hatched just before the leaves of the mulberry tree come out, so that we have a difficulty in feeding them. It does not seem that we have been able here or anywhere else to retard their coming out of their eggs. We are therefore compelled to substitute the lettuce and the dandelion, which both yield a very similar milky juice to the mulberry, and the creature will rather feed on these than die: but it is a fact that silkworms, fed in their early condition on lettuce leaves never thrive like those always fed upon mulberry leaves. Various attempts have been made to cultivate the silkworm in Great Britain. The black mulberry was introduced, and there are large orchards remaining which were planted centuries ago, but all attempts have failed owing to the worms hatching before the mulberry leaves come out. At the same time there is no reason why it should not thrive, as it succeeds in Russia and various parts of North America, and there are silks in this room from various parts of Great Britain. But the question is how can we obtain silk from our worms permanently without any of that liability to failure which has attended the cultivation of silkworms in this country? I recollect at various meetings of the British Association a lady appeared from time to time bringing specimens of silkworms and manufactured silk, endeavouring to show the gentlemen of the Association that it was possible to produce it here, and I recollect a very splendid piece of silk so produced, which was presented to her Majesty. But how did Mrs. Whitby of Southampton do this? Instead of cultivating the old black mulberry she cultivated another species—the *morus multicaulis*, having a leaf and fruit of a different kind, and not so eatable as the common black mulberry, but producing leaves much earlier than the *morus nigra*, and on this account she succeeded from year to year in producing good crops of silk of the best quality; according to her experience, therefore, it must not be decided that we cannot cultivate silk in this country, and I therefore recommend it to the study of all who are seeking for further means of obtaining money. There is no question that the time of females might be profitably employed in attending silkworms where they have nothing better to do. It is not a very profitable employment, still it only occupies a little time and attention, and when carried out it produces a clear gain. This is a fit subject for the philanthropist, as the cultivation of silkworms could be carried out in a cottage population. There is one great drawback, namely, the disease to which they are subject, the *muscardine*, and those who are at all engaged with manufactures of silk, in the sale of silk, or in the purchase of silk, well know how this has caused it to vary in price; how large quantities have been brought into the markets of Europe affected by the disease, and how within the last four years the greater part of European silk has been destroyed by this cause. Now the disease is of a kind that sometimes affects the human body. I have here a diagram of human hair affected by fungus, and diseases of the skin are produced by the same cause. Now a fungus of a very similar kind attacks the silkworm, and so entirely destroys the creature that when the time comes for it to form its cocoon it is utterly unable to do so, and the result is a failure in the crop. It has been found lately that feeding them with sugar prevents the disease, and it further appears that it is a disease produced by over crowding: those people who cultivate silkworms crowd them together in close places without a proper supply of pure and fresh air, and when a large supply of fresh air has been admitted to the cases in which they have been kept the disease has disappeared. There is no doubt that the disease will spread from one establishment to another, which shows that the same laws which prevail in the life of man prevail in the life of animals.

Now, there are several sorts of silkworms, just as we find among human beings that there are small ones and large ones, black ones and brown ones and white ones, so we find among these creatures a similar variety. In France there is the *sina* variety which produces white silk, and there is the Syrian which produces a very large cocoon. Then there is the *snowbee*, which is the small fine cocoon producing yellow silk, the most beautiful of the French silk. The *bombyx mori* is not found in our fields or hedges, for although occasionally a few eggs may fly out of the windows and get into our hedges, yet there is something in our climate which will not allow them to thrive. The year before last

was an exceedingly favourable summer for the production of these creatures in the open air, and a statement was made at the meeting of the British Association at Leeds by a gentleman that he had seen them feed and thrive in the open air. The worm is essentially a native of China. When our forefathers were naked savages understanding nothing at all about clothing, more than three-fourths of the population of China were clothed in silk. This is a lesson for us. The Chinese have not been a people of progress. They are almost a stereotyped edition of the human race. There they were 2000 years ago making silk in large quantities, and here they remain at the present day with no increased advantages, whilst we are continually progressing. They practise things merely as an art and know nothing of science. We see them the suppliers of the world not employing machinery in the manufacture, but doing just as they did 2000 years ago. The cultivation of silk seems to have been introduced into Hindostan and then to Europe at the time of the reign of emperor Justinian, and it was introduced into Constantinople by two Nestorian monks who were promised a reward if they would bring the worms which produced the silk. The Greeks and Romans knew something of silk, but none of them knew anything of its history. Aristotle thought it must have been produced by some worm like a caterpillar, and others thought it was the produce of plants, and certain Roman poets attributed it to flowers. In the sixth, seventh, eighth, and ninth centuries the silk known in Europe was entirely the produce of the Greeks. In the thirteenth century it was introduced into Sardinia where it found a home. In the fifteenth century it was introduced into France. In the sixteenth century it was introduced into England, but failed. Throughout all Europe silk was, until a very recent period, an article of excessive value. We find James the First, when the English ambassador went down to congratulate him, writing to the Earl of Marr to beg of him to lend his sovereign a pair of silken hose, so that his sovereign should not appear as a scullion. Nor had we been more successful in the manufacture of silk up to the seventeenth century. Although we attempted to grow it we failed, and we were in the same position as to our manufacture. Most of you have heard of the Revocation of the Edict of Nantes. This threw upon our shores 50,000 intelligent Frenchmen—many thanks to them—we are more indebted to them than at present people would like to confess. The Frenchmen established a silk manufactory in this country, and, although we could not rear the silkworm, we were able to manufacture silk, and now we have a great trade in the article. In 1820 we imported 371,000 lbs. In 1856 our importation amounted to nearly 7,000,000 lbs. In 1857 and 1858 it had amounted to 7,000,000. We have at this moment 300 silk manufactories with 2,000,000 of spindles going, and steam machinery of 4000 horse-power, independently of the hand weaving of Spitalfields. We have 15,000 men and 35,000 women employed in the manufacture. The quantity of silk that we use is something prodigious, and the entire quantity of this silk fibre is enormous. In Lyons, the manufacture has been carried on to a great extent, and a manufacturer of 1840 states that the silk consumed was 2,205,000 lbs. and that it was produced by four thousand millions of cocoons. The fibre of one cocoon measuring 1526 feet in length, so all the silk fibre used in one year in Lyons would measure six billions five hundred thousand millions of feet, a quantity sufficient to wind fifty-two thousand times round the circumference of the earth. So much for the manufacture of one town alone, and, of course, our home manufacture is much larger than that. The silk used in our manufactures is produced in various parts of the world. We obtain it from France, from Italy, from Sweden, from Russia, and especially from China, and now from Japan, and recently some of it came from America. After the creature has cast its skin five or six times it begins to form its cocoon; this is done by fixing the upper part of its body in such a way that it can reach around itself in every direction, and cover itself all over with the web which it spins, and at last form with it the hardened case which we call the cocoon. The way in which this is done is very curious, and I will draw your attention here to two large glands found on each side of the body of the silkworm. It is in those glands that the silk is secreted, running on to the front of the head and terminating in an organ called a spinnaret. On each side of the spinnaret are two glands, with a sticky matter very much like the silk itself, by which the produce of the two glands are made to adhere together and produce one fibre. This substance, when placed under the microscope, is found to have the appearance which you see here, it is transparent, and composed of a material called *seracine* by chemists. Silk fibre, of all substances that we know in nature, has the greatest strength for its size. So that you see it is in its great strength and fineness that its value consists. The way in which the silk is obtained for commercial purposes is in this way:—The creatures are allowed to feed upon the mulberry leaves in a large shallow basket, and in a short time they spin a cocoon. Several of these cocoons are taken and placed in vessels upon a table, and each end of silk is placed upon a reel, then, as the reel goes round, the silk is wound off, and thus formed into what we call hanks. It is in this condition when brought into the market. This is some from Canton. I believe some of the finest white silk is brought from China. I have here three specimens of American silk. The great drawback to American silk is that it is not uniform in its colour or quality; this is coffee-coloured, and this straw-coloured, and sometimes the American silks are almost green. I have here some specimens from Siam; these are not produced by the common *bombyx mori*. Here I have some from Russia. Even in Russia they can produce silk, and, as I said before, the reason that we cannot seems to be more from our want of management than anything else. Here is some of the fine silk from Japan, which has recently created a great sensation on account of its whiteness and strength, and it is now being used in a manufactory in Nottingham. This is silk from India, which retains its character for beautiful silk. Here is some Sicilian silk, and these are in the form in which they come into the market for the purpose of being manufactured. This is called *raw silk*. Now the raw silk is spun into what we call spun silk, and you have it twisted on these wheel spindles, and then afterwards rewound into the form of these small hanks, and it is in this way that the silk finds its way into the market in the form of silk yarn. The next process to which it is submitted is the process of dyeing. This spun silk is taken to the dyers, who submit it to a variety of colours. We have black, blue, and red dyes, of various shades; for black, galls and iron, with indigo, are the most frequent substances used for dyeing; but there is a great fraud in dying blacks. Silk is made to weigh 25 per cent. more when dyed than before, because it will take up a considerable quantity of sugar, which makes it assume a weightier and stouter appearance. You may easily ascertain the presence of sugar by the taste. The red colours are given by the agency of cochineal and lac, which colours are produced by these insects.

It would be out of my province to deal with the different manufactures, but I will call your attention to the variety of forms in which silk appears. We have the plain silks, the figured silks, and the beautiful surfaces called satins and satinettes. Then we have a very peculiar form of silk which is made into shawls; then silk lace, in the manufacture of which there are a thousand women employed in Nottingham. Then we have damasks and brocaded silks, and this poplin, which is composed of four parts of wool and one of silk, with gold pattern introduced into it. Here I have a manufacture from Japan, which is a mixture of hairs and silk. I have here some beautiful crapes presented to her Majesty, and by her Majesty presented to this museum. You can hardly imagine any thing more beautiful than these. Then I have here from Coventry a large variety of beautiful colours in ribbons.

During the manufacture of this silk into those various fabrics we have a large quantity of waste. We bring into this country a huge quantity of cocoons which have had their

silk reeled off, and they are called knubs and husks, which still yield silk used for coarser goods. I have here a quantity which is known as silk waste, which is also rewound and used into a variety of fabrics, so that no portion of the fibre is lost. Even in China after they have taken up the knubs and husks they take the chrysalises and make of them the most delicious mess with which they are acquainted as an article of diet. Strength is the appellation which is best applied to these little glands which form the silk, and I have here a substance manufactured from those little glands, and called silkworm gut, which makes an exceedingly strong and useful article for the purpose of the angler; and those who are fond of fresh-water fishing, such as for salmon and other kinds of fish, will appreciate this silkworm gut. So you see there is not any part of our little creature which is not more or less useful to man. I have no time to allude to the other insects on the table. I have spoken of the fact of the cochineal and lac producing dyes. This beautiful lac dye is produced by the creature which produces shellac, from which we make sealing wax, and this cochineal, which is valuable in medicine, produces crimson dyes. I now only bring forward the silkworm insect as a contribution of the invertebrate tribe of animals for the use of man and manufactures.

SOCIETY OF ARTS, 18 *April* 1860.

Thomas Winkworth, *Esq. Vice-President, in the Chair.*

The paper on *Indian Fibres*, announced for this meeting, was, owing to the indisposition of Dr. Forbes Watson, deferred *sine die*, and in lieu thereof Dr. R. H. Collyer delivered a discourse upon *Paper Material*, which we will tersely notice. The Author's opening remarks were devoted to the consideration of rags, and the ordinary methods of sorting, cleaning, bleaching, and pulping them; from which we learn that the loss incurred in these various processes, before the "finished article" is obtained, amounts to from 30 to 50 per cent on the weight of the rags employed.

Dr. Collyer then said: "I feel certain that rags are the most expensive material that can be used, nor can they produce paper equal in strength and durability to raw materials, when these are treated judiciously.

"I have a friend in the United States, who is now manufacturing some 30 tons of paper each week, the ingredient being principally wheat straw. The process consists in boiling it, under a pressure of 200 lbs. to the square inch, in a large spherical boiler of 14 feet in diameter. In this vessel he acts on some 10,000 lbs. of straw at one operation; it requires some four to five hours to get the whole to the heat of 320° Fahrenheit, which he continues for some 24 hours. He then removes the man-hole of the boiler and injects cold water, so as to be able to remove the material which is by this time compacted into a large glutinous mass, raw materials having a tendency to this agglutination when boiled in bulk. The object of these operations is to get rid of the silica and gluten. As a like process is used in England by other paper manufacturers, possibly with some modifications, my description will equally answer for other cases. High-pressure boiling involves a great sacrifice of fuel, nor is the object attained, for though the steam in the boiler acquires a very high temperature, the liquor itself is much lower.

"Now I ask any one who has seen these operations, can the alkaline liquor or the heat permeate a mass of material so matted and packed together? It is a well-known fact that this treatment is so unequal in its effects, that one batch or boil may turn out far better than the next, and also that those portions which come readily in contact with the alkaline liquor are sufficiently prepared, while those in the interior may be hardly acted on at all. The same objection exists in boiling rags. A paper maker of 40 years' experience told me the other day that frequently one portion of the rags was cooked when the rest was nearly in the same state as when first put into the boiler. This is particularly the case when over half a ton is boiled at a time. This statement has been corroborated by several of the most prominent makers, with whom I have lately been thrown into contact.

"Surely, then, if rags, which are free from those glutinous and gummy matters which invariably accompany raw materials, are subject to this difficulty of imperfect boiling when acted on in quantity, how much more must this be the case with the raw material?

"It is true that various contrivances have been adopted for obviating these inconveniences. Some have revolving boilers; others cause the apparatus to perform a semi-revolution, but no practical advantage is obtained. I now refer to raw substances, for with rags, in consequence of their freedom from gummy and glutinous matter, the revolving boiler saves both alkali and time, and ensures more uniform results.

"I now come, gentlemen, to that portion of my remarks in which I shall have to treat of processes which profess to remove all the obstacles attendant on the use of raw substances. I will show that what now requires from 8 to 14 hours to accomplish can be effected in 2, and that what now takes from 2 to 3 days may be perfectly well managed in 6 hours. Such a revolution in the preparation of paper material I did not in the least anticipate when I commenced my experiments five years since. If my observations do not appeal to your judgment as being based on correct chemical and mechanical principles, I must not expect to receive your assent or approbation. But I have done more than theorise on the matter, having erected machinery in my garden on a scale of sufficient magnitude to prove the process capable of being carried to any required extent. I should be happy to be visited by any of my audience or their friends, when I think it will be in my power to convince them that paper of every quality can be made quite independently of rags — at less than half the cost — of this fact I am certain. My process consists, first in passing the straw or other material between two rollers—running at different speeds—this produces a trituratory action, which in the case of straw, rubs out the knots and ears; these have always formed an insuperable obstacle in the case of straw, producing specks in the paper; the knot in particular is most difficult to bleach. So also is the ear. I am aware that those who make straw paper attempt to get rid of these by cutting the material into short lengths and winnowing them out, but it can easily be imagined how imperfectly this process must effect the object in view. The rollers also prepare the straw by opening it out into a partially fibrous state, so that it occupies only half the space it would take up in its natural condition, and besides the alkali has a more ready access to the fibre. In this condition it is packed in sieved trays, about one foot and a half in depth; these are placed in an apparatus to be operated on in detail, that is, each layer is supplied independently with a current of steam and alkaline liquors.

"In lieu of filling, for instance, with alkaline liquor, a vessel of 8 × 8 feet, having a capacity of about 400 square feet, or 2500 gallons, I only employ 500 gallons, of a strength of two degrees, or about three ounces of caustic alkali to the gallon—in fine, not over 1 cwt. of soda or potass to the ton of straw, whereas at present very few makers use less than from 4½ to 5 cwt. This is effected by using a reservoir at or near the bottom of the apparatus or vessel in which the materials are treated. From this reservoir the alkaline liquor is pumped to one above, from which the distribution takes place uniformly to each layer or stratum to be acted on. When perfectly saturated, the superheated steam acts under each stratum by an independent supply. The excess of alkaline liquor falls over the sides of the tray down to the bottom of the apparatus. In this manner a system of percolation and circulation is kept up for 40 minutes to one hour, when the spent liquor is drawn off, and the reservoir is refilled with fresh liquor, for it must be borne in mind that by this time the alkali, though not chemically neutralised, has lost the power of acting on the silica. I could enlarge, if time per-

mitted, on this topic, as illustrating one of the principal causes of failure in the modes now in use.

"The escape steam is not lost, for it enters tanks in which the alkaline liquor or water for washing is first boiled, for it is most important in the treatment of raw material that cold should not be brought in contact with it until the operation is complete, so far as the removal of gluten and silica is concerned. The paper now supposed to be made of straw, which in most cases is a mixture of cotton rags, is condemned as being brittle, harsh, and having an unpleasant rattle. These faults arise from the silex being only partially removed; this circumstance has caused a great prejudice against those papers.

"When the alkaline liquor has been drawn off, after one one hour and a half's treatment, the material is next washed, without removing it from the apparatus. This is effected by turning certain cocks which communicate with the lower reservoir, and admit the hot water. The straw is agitated by a simple contrivance, which causes every part to be repeatedly turned over. This washing process takes from 30 to 40 minutes; this is determined by the escape water running clear. The analogous operation occupies several hours at present, and is, after all, but imperfectly performed.

"The fibre is now clean, but to ensure a certain result I fill the reservoir with cold water slightly acidulated with hydrochloric acid, the cover of the apparatus having been previously removed. This cold solution is now mixed thoroughly with the material for about ten minutes; it is then washed away with extra cold water.

"I now come to that portion of my invention which is attended with the greatest economy of bleaching material.

"The solution of chloride of lime is completely mixed and incorporated with the straw, after which the superheated steam is let in at a pressure of from 30 to 40 lbs. It permeates the whole mass under treatment, the agitators being kept at work the same time.

"The bleaching is effected at once and more perfectly than if the material remained in a solution of chlorine for a whole day.

"This is easily understood, when the process or chemical change is analysed. It seems the chlorine combines with the hydrogen of the water, forming hydrochloric acid, while the oxygen attacks the vegetable fibre. The principal obstacle has been the deposit of the lime on the surface of the fibre, preventing in a great degree the further action of the bleaching process. By the employment of great heat, suddenly applied in the manner I have patented, the best and most uniform results may be relied on.

"Instead of washing out the acid formed, I prefer neutralising it by the addition of chalk or other substances, extensively used to give weight and opacity to the paper.

"The pulping operation is now to be performed. I would here state that for this purpose the present appliances are most rude and inefficient, there being no uniformity of result; some portions are thoroughly reduced, while others are hardly touched. Too much importance cannot be placed on this particular part of the process of preparing materials for the paper machine. I propose using an apparatus which rubs rather than cuts, so that with raw fibres, which are tender in the humid state, the greatest length is obtained. This object it is impossible to attain with the beating engine now in use."

In conclusion, the Doctor observed that there had been no marked improvement in the paper manufacture during the last fifty years, for the greatest difficulty had ever been, *not* to find materials, for such existed in great abundance, but to discover economical and practical methods of converting the same into good and strong paper. He had himself, some years back, endeavoured to introduce for this purpose the residue of the beetroot after the sugar had been extracted, which he considered one of the best and most available materials. It could be obtained, he said, in large quantities, at a low price, and had the advantage of not losing more than ten per cent. in the course of manufacture. His beetroot patents were in the hands of Messrs. Grosvenor, Chater, and Co.

The Chairman having invited discussion upon the foregoing paper,

Dr. Riddell said that the great objection against straw paper was its brittleness, arising from the quantity of silica it contained. He presented a specimen of a fibre which contained no silica, and which, he believed, might be prepared at a cost one third less than that of rags. He would also show some paper made from the fibre of the *Hibiscus esculentus*, a plant of about eight or ten feet high, yielding good food for cattle, while its bark contained the fibre referred to. He also named the fibres of the *Agave americana*, the *Sorghum saccharatum*, as suitable paper materials.

Dr. Watts, Mr. W. Hawes, and several other speakers, addressed the meeting in turn, but their remarks were not of a kind to interest our readers, being chiefly of a political, or politico-economical character. After having passed a vote of thanks to Dr. Collyer for his paper, the meeting adjourned.

NOTICES OF PATENTS.

Improvements in the preparation of Peat and Charcoal for Fuel, in the Manufacture of Coke therefrom, and in the Machinery and Apparatus employed for effecting the same. C. Kingsford.

Peat — that *ignis fatuus* of chemical inventors — has been tortured by every conceivable mode in the hope of forcing it to yield up some of the treasures supposed to be concealed within it. There is scarcely a substance that can be formed on paper, by adding together atoms of carbon, oxygen, hydrogen, and nitrogen, that has not been supposed to be obtainable from peat. Sanguine politicians have pointed triumphantly to the peat bogs of our much maligned sister isle as a perfect El Dorado. They have looked forward to the time when the epithet "bog-trotter" shall be a title of honour, not of derision; to the time when whisky, potatoes, and pork shall all be yielded directly or indirectly by the combustion of peat. Peat has formed the pivot round which systems of finance have revolved, and on which swarms of adventurers have lived; it has inspired the muse of some, and has proved the amusement of others, the prospectus-makers have praised it, the distillers have burnt it, the paper-makers have masticated it, the candle-makers have looked wistfully at its paraffin, the hatters have sniffed suspiciously at its wood-spirit, the water-proofers have taken the boiling point of its hydrocarbon naphtha; theorists have talked poetically of its pittacal, and, *facilis decensus*, water-closets have been deodorised with its charcoal. And yet the problem of the economical working of the peat bogs is yet unsolved; and, although we have unlimited faith in the powers of chemistry, we confess to preferring one acre of good wheat growing land to (say) six acres of the most intense bog ever trotted over.

Nevertheless, here is a new patent proposing a plan for converting peat into good fuel, and, moreover, the proposed process appears tolerably feasible, and contains none of the dreadful absurdities too commonly found in peat patents. The following is an abbreviated sketch of the final specification:—The patentee digs the peat, and while wet "pugs" it with a certain quantity of powdered pitch, the fibres of the peat thus become broken and felted, yielding a compact fuel which when coked yields a hard charcoal which the patentee says, well resists a blast. He also works up peat charcoal dust with pitch or resin, and after heating to about 300° F. moulds the product; it is subsequently carbonised in retorts. By this means the inventor states that he attains a very hard and superior coke suitable for industrial or metallurgical purposes. The chief part of the patent is taken up with a description of the pugging-mill employed; it appears tolerably simple and practical, but we doubt whether there is sufficient

novelty in it to allow of its being claimed. The general features of this patent are a straightforward and clear description of the patentee's meaning, and an absence of the absurd claims and unnecessary verbiage which disfigure so many chemical patents.

Improvements in the Manufacture of Artificial Fuel.
JAMES SHAW.

"THE object of this invention is to render the dust or small coal available for fireplaces of the ordinary kind by an admixture which will have even a better effect than the best kind of lump coal, and is effected in the following manner: — To a given quantity of small coal or coal dust I add about one fourth its bulk of lime, and thoroughly incorporate together, after which I slightly moisten the whole sufficient to bind them, when the mixture may be formed into suitable blocks by any of the known means, the result being that a more intense heat is obtained with less cost, and at the same time will last considerably longer than ordinary coal. This fuel is also well adapted to the generating of steam and other such like useful purposes."

We rather imagine that to bind coal and quicklime together by slightly moistening the mixture would puzzle even the patentee. Where is the extra heat to come from? Heat is generally in the ratio of the substances burned, but burn quicklime as he will, the patentee will not get more heat from it than was afforded by the fuel used to heat it. As for lasting longer than ordinary coal, we grant unreservedly that lime will stand the fire to any extent, and in this sense a pound or two of quicklime would be a most durable substance to have in a house. But quicklime dust is unpleasant in the eyes or nostrils, and to poke one of our patentee's fires would therefore require some courage. And then the furniture! In short, the patentee, after entering his provisional specification, evidently tried his process, that, doubtless, being a sufficient reason for his never completing it. There are hundreds of persons who have brought forward processes almost identical with that before us, and there are numerous patents involving the same idea.

CORRESPONDENCE.

The Truth of Latent Heat as an Explanation of well known Phenomena.

To the Editor of the CHEMICAL NEWS.

SIR,—In my last communication I made use of this phrase, but I must observe only as expressive of the existence of a certain order of phenomena; for that heat is ever latent in the sense now understood by philosophers I cannot persuade myself, and will briefly, although I hope fairly, set forth wherein this doctrine appears to me wanting in philosophical accuracy.

The heat produced by the slacking of lime is said to be owing to the water becoming solid, in which state it gives off that heat necessary for its fluidity. This supposes that water in its fluid state contains a certain amount of heat, although, according to our usual standard, it would be pronounced cold; and the supposition is evidently a correct one, inasmuch as its heat may be felt by plunging the hand previously into a mass of snow or ice, or better still, some freezing mixture. But the heat evolved is said to have been in a latent state; and this is a doctrine the truth of which I altogether fail to apprehend. Here we have apparently cold water poured upon a certain earth, and the product of this union is a considerable amount of heat, and an impalpable powder. This is obviously, according to the general and very vague acceptation of the phase, a chemical union; although, if a definition of this is required, it can only be said that the distinction between chemical and mechanical union lies in our being enabled to understand the latter, while the former phenomenon is not at present appreciated by philosophers.

Now I submit, with every deference for the opinion of others, that all the physical evidence we have is this: we find the union alluded to productive of considerable heat, and a certain powdered substance. Any speculation as to the direct cause of the heat cannot be said to come under this evidence, for all speculation is widely distinct from ocular or experimental proof. Yet it is of course fitting that we should logically investigate this question. And I must commence by remarking that the notion of anything existing in a latent condition appears to me peculiarly unphilosophical. We have heard of latent light, and to my mind the latent state of heat is quite as surprising and unintelligible. That heat can exist without being in any way capable of experience is a proposition which I must see absolutely necessary of acceptation before I can receive it. And in the example brought forward, as in fact concerning all phenomena where latent heat is supposed to play a part, it does not appear to me that we are brought to this alternative. The doctrine reminds me of one connected with metaphysics, where it is supposed that ideas may exist in the mind without being known to its author. This notion is now almost, if not altogether, cast away as absurd; and I apprehend that the similar doctrine of latency, as connected with any physical elements, must soon be refused by the philosophical community.

The cause of the heat appears to me to be exceedingly evident. A chemical action is produced in the way described: it will be seen that I am not bound to explain this, in order satisfactorily to account for the heat. As to the principle, it may, without doubt, be said to be that of the meeting of the various forces of matter, and their consequent interaction; or, if matter is but force, of the two material substances or forces themselves. Now force is nothing but a general term for friction; and the friction of these forces upon such an ether as I supposed in my last communication, would, when transmitted by it to the human frame or any other test, at once affect as heat. I admit that, for the present, we are not not enabled to demonstrate the existence of an ether, so that this explanation is suppositional; but, to my mind, it has none of the what appear to philosophical objections, appertaining to the doctrine of latent heat. And I consider it applicable to every case where latent heat is supposed truly to explain scientific phenomena.

And now to consider some other cases exclusively accounted for upon this doctrine. It requires 142°·65 of heat to liquefy a pound of ice, at 32°; after which process the water has not received any apparent heat: therefore, as it is supposed that the heat received must have produced some constitutional interaction, and as, moreover it is not sensible, it is set down as having become latent. I confess that to my own mind such an explanation as this is by no means satisfactory; and I doubt not that it arises from the strange doctrine of heat, which at the present time occupies the philosophical mind. Now in the above experiment, all the direct physical evidence we have is this: it is found that a certain amount of a certain substance, at a temperature of 32°, requires 142°·65 of heat to render it liquid, after which no accession of heat can be discovered. I see, however, no difficulty in explaining this phenomenon. Taking heat to be nothing more than the vibration of some ether, it is quite conceivable that the process of melting should prevent this being experienced, or more properly, that this process is the result of the vibration of such ether. After the liquefaction, apparently after the vibrations have been absorbed in this process, the thermometer rises, seemingly because these vibrations are not then so connectedly absorbed into the substance, but, as the vibrations of heat in their usual condition affect this instrument. It seems to me that the reverse of this experiment presents no more difficulty. A thermometer immersed in a vessel of water at 32°, does not sink while this is becoming solid, although heat is then known to be evolved. But after the solidification it of course registers its apparently decreasing temperature. In proof of the assertion with respect to heat, the same instrument would

rise if suspended over the vessel. It must be allowed that we know little or nothing of the motion of the particles of bodies, understanding this word how we please. And I apprehend it quite possible that the vibrational motion surrounding us, which we call heat, may so act upon the particles of a body, as to render it solid, without affecting an enclosed thermometer, and much less the duller apprehension or sensibility of the human frame. Consequently, whether water is artificially or naturally solidified, I see no reason for supposing the discharge of anything in the form of concealed or latent heat. In this example decrease of temperature, however brought about, produces solidification, with the presence of a certain amount of heat. As to the solidification, there is, as to the broad principle, little or no difficulty, it being known that heat, by repelling the particles of bodies, keeps them fluid, or in the condition of repose. It is the sensible heat evolved which has given rise to the doctrine of latency. Now it appears to me by no means impossible that the action producing solidification, as friction upon some ether, affects as the heat supposed to be latent. It may not affect the enclosed thermometer for the reason already offered, or because the ether, which, if the hypothesis is true, is contained in the substance, for everything will afford some sensation of heat, if properly examined, cannot be rightly acted upon by the atomic action, produced by the external diminution of heat, or by the heat vibrations themselves becoming fainter.

I am well aware that many phenomena connected with steam, will be considered altogether fatal to the explanation here set forth; yet I cannot say that such appears to me. When I consider the amazing amount of friction which the condensation of steam must generate, I can see in this an explanation of the heat which condensing steam imparts to many times its bulk of water. But I shall not now enlarge upon this. As to the heat produced by percussion and friction, I apprehend that the ether, which all bodies appear to contain, is set into vibratory motion by the percussional or frictional forces employed. And perhaps the ether surrounding all bodies is by these methods brought into action: and this most probably explains the heat produced by condensation or compression, where the ethereal element is only somewhat differently produced, and directed to a certain object. It has already been inferred that when solids become fluid, heat is absorbed. A notable instance of this is found in the freezing of mercury by a mixture of snow and chloride of calcium, which causes a very sensible diminution of the heat of the apartment in which it is performed. When I speak of heat being absorbed, I only intend to convey the idea of a vibrational ether penetrating the particles of bodies. It appears to me that such an element is both within and surrounding everything apprehensible to man; and I think also that this element is everywhere in a condition somewhat vibratory, inasmuch as there is no body, or combination of substances, except perhaps one or two freezing mixtures, which cannot by comparison be demonstrated to contain a certain amount of heat. And there is no reason at all for supposing that these exceptions can be pronounced cold; but, on the contrary, it is only philosophical to conclude that man is unable to rid himself entirely of the sense or presence of heat. I have endeavoured to unfold in these observations a general explanation of well-known and very important phenomena, less cumbrous and more intelligible than the now generally accepted doctrine. But of course these points would be nothing, were the question of truth not concerned.

I have met with the extraordinary expression of "heat of space." It is proper to conclude that those who make use of this and similar expressions, forget that upon no doctrine of heat, whether material or spiritual, can mere space be said to possess it. For space, as Kant remarks, is only the subjective condition of the mind, under which alone the knowledge of external things is possible.—I am, &c.

J. A. Davies.

MISCELLANEOUS.

To ascertain whether a Room is Damp or not.—Place a weighed quantity of fresh lime in an open vessel in the room, and leave it there for 24 hours, carefully closing the windows and doors. At the end of the 24 hours reweigh the lime, and if the increase exceeds 1 per cent. of the original weight, it is not safe to live in the room.—*Cosmos.*

Influence of Animal Food on the Colour of the Skin.—M. d'Abbadie, the African traveller, writes to M. Quatrefages, that the flesh-eating blacks south of Nubia have a much lighter complexion than those nourished on an exclusively vegetable diet. It is also pointed out that the negroes in Kabylie who eat flesh have a very light complexion, while preserving the crisped hair and all the other characteristics of the negro race.—*Cosmos.*

Covering Zinc with Brass or Copper.—To give zinc a coat of copper or brass for the purpose of a subsequent silvering or gilding, the following solutions are used:—for copper alone, a solution of sulphate of copper, saturated at the common temperature, is mixed with a solution of cyanide of potassium, adding as much of the latter as is necessary to dissolve the precipitate thrown down at first. The hydrocyanic acid disengaged during this operation must be carried off by a draught or flue. When the mixture is clear one-tenth or one-fifth of its volume of *liquor ammoniæ* is added, and diluted with water to density of 8° Beaume. For brass, blue and white vitriol are used in equal proportion, and prepared as before. Two parts of sulphate of zinc and one of sulphate of copper give a bright brass coating. Previous to their dipping the articles of zinc are rubbed thoroughly with finely-powdered pumice-stone and rinced in water, after which manipulation they are placed in the bath and remain there for 24 hours. After that time they are again rinsed in water and simply wiped off. The copper or brass coating has a very bright look, as if polished, and adheres perfectly. The thickness of the coat may be increased afterwards by the aid of a battery.—*Le Technologiste.*

Acidity of Brown Bread.—Liebig says that the objectionable acid taste which (the German) brown bread ordinarily possesses may be prevented by using some lime water in making the dough. He recommends about 50 pints of lime water to 2 cwt. of flour.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Our usual "Chemical Notices from Foreign Sources" are unavoidably deferred till next week.

G. F. R.—The drawing was made to a scale of one half. Dr. Andrews has also employed a larger apparatus of a somewhat similar construction, but about twelve times the internal capacity of the one represented.

A Subscriber (Stratford).—*Œnanthic ether* is prepared by heating 5 parts sulphovinate of potash with 1 part of œnanthic acid. The mixture fuses and an oil rises consisting of œnanthic ether and an excess of œnanthic acid. The latter may be removed by heating with carbonate of potash. *Œnanthic acid* is obtained from the residue left in the retort on rectifying fusel oil over potash-ley. This residuum is mixed with dilute sulphuric acid, when œnanthic acid separates and collects on the surface in form of a fatty layer.

J. H. O. will be communicated with.

A Constant Reader.—The candidate is recommended for election by some fellows and members of council, and after some preliminaries is balloted for. Apply to Dr. Odling or Professor Redwood, the secretaries.

Received.—*A. Domeier*—*Mr. J. A. Davies.*

W. L. C.—In type.

T. C.—Probably the benzole was very impure.

X. Y.—An abridgement of the *Essay on Fermentation* will appear very shortly.

T. C.'s communication will receive early attention.

NOTICE OF REMOVAL.

Subscribers and the Trade are respectfully informed that the Office *of this Paper has been* Removed *to* Mitchell & Co.'s, 12 *Red Lion Court, Fleet Street,* Next Door *to the former Office.*

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publisher, at the Office, 12 Red Lion Court, Fleet Street, London, E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Detection of Chromium in Presence of Iron, by F. H. STORER.

It is customary, in the methods of analysis now most commonly employed in laboratories of instruction, to rely upon the solvent action which the caustic alkalies exert upon hydrated sesquioxide of chromium as a means of separating this base from the oxides closely allied to it. It is well known, however, and the experiments of Northcote and Church [1] have determined the fact quantitatively, that when a small amount of sesquioxide of chromium is accompanied by a large quantity of the oxides of manganese, cobalt, nickel, or of sesquioxide of iron, it ceases to be soluble in the alkalies. From the frequency of its occurrence, as well as from the fact that it has the power of concealing a larger amount of chromium than either of the other bases which have been mentioned, the sesquioxide of iron in particular gives rise to much inconvenience in practice. It is a constant source of annoyance to beginners, who almost invariably fail to detect the presence of chromium in solutions containing it given them for analysis, if these at the same time contain iron also. In this case it may be detected, it is true, by fusing the mixed precipitate of oxide of iron and of chromium with nitrate of potash and carbonate of soda, and examining the aqueous solution of the mass obtained for chromic acid; but the student seldom applies this test, unless specially directed to do so. The operation is troublesome, since it necessitates the employment of a special set of tools, and occupies considerable time. It is as a rule distasteful to the student, and is rarely resorted to even by experienced analysts, unless the colour of the solution, a preliminary blowpipe test, or some incidental observation, has already indicated the probable presence of chromium in the substance under examination.

It is obvious, that if the chromium in the mixed precipitate could be oxidised in the wet way by some simple and rapid method, it would not only be more readily detected in any case, but the chances of overlooking it altogether, an event now so liable to occur, would be materially lessened.

Frommherz [2] long ago noticed that chromic acid is formed when an aqueous solution of a salt of chromium is treated with a solution of permanganate of potash, a fact which has since been corroborated by Reynoso [3], and still more recently by Cloez and Guignet.[4] Reynoso has suggested, moreover, that this reaction may be employed for the detection of chromium, especially if the chromic acid formed be subsequently converted into Barreswil's perchromic acid.

Chancel [5] on the other hand, has observed that chromic acid is formed when sesquioxide of chromium is heated with solution of caustic potash in presence of peroxide of lead, as may be shown by acidifying the filtrate from this mixture with acetic acid, chromate of lead being precipitated. He has also proposed [6] that this reaction shall be used as a test for the detection of chromium.

After a number of experiments upon the subject, I have satisfied myself that peroxide of lead is as good an agent as any at our disposal, if it is not the best, for effecting the oxidation of sesquioxide of chromium by the wet way, while the formation of perchromic acid is unquestionably the most delicate and characteristic reaction for chromic acid which we possess. This note, therefore, must be considered as being merely supplementary to the statements of Chancel and Reynoso.

Besides the observations of these chemists are those of Balard [7] that oxide of chromium is immediately changed to chromic acid when treated with a solution of hypochlorous acid; and of Carney [8] who has found that chromic acid is produced when a galvanic current is caused to flow through a dilute solution of caustic alkali in which sesquioxide of chromium, even that which has been ignited, is suspended.

For my own part, I have observed that sesquioxide of chromium may be converted into chromic acid in the wet way by the agency of several substances besides those already mentioned, and that the presence of free alkali, so far from being necessary, as has been implied by previous observers, with the exception perhaps of Frommherz, is not by any means essential in most instances to the success of the operation, oxidation occurring very readily in several cases in strongly acid solutions.

A dilute solution of chrome alum, which by experiment was ascertained to contain no chromic acid, was acidulated with sulphuric acid, a little peroxide of lead was added, and the whole boiled; on filtering, the solution was found to be of a yellow colour, and readily afforded the reaction of chromic acid when tested with dilute solution of peroxide of hydrogen, viz. a magnificent blue colouration due to the formation of perchromic acid.

A solution of permanganate of potash, acidulated with dilute sulphuric acid, being substituted for the peroxide of lead in the preceding experiment, produced a similar result. Peroxide of manganese also replaces perfectly the peroxide of lead in this experiment.

It is not even necessary that these mixtures should be heated. Dilute solution of chrome alum, acidulated with sulphuric acid, and mixed with a small portion of peroxide of lead, having been allowed to stand in the cold, was found to contain traces of chromic acid at the end of half an hour; after standing eighteen hours, a considerable quantity of chromic acid had formed.

A similar solution, in which peroxide of manganese was used instead of the peroxide of lead, gave a fine reaction of chromic acid at the end of eighteen hours.

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[1] *Qu. J. Chem. Soc.* vi. 53.
[2] *Schweigger's Journ. f. Ch. u. Phys.* 1824, xii. 281.
[3] *Ann. Ch. et Phys.*, 1851 (3), xxxiii. 324.
[4] *Comptes-Rendus*, xlvii. 712.
[5] *Ibid.* xliii. 928.
[6] *Loc. cit.* and *Précis d'Anal. Chim. Qualit. par Gerhardt et Chancel*, (Paris, 1855) pp. 112, 289.
[7] *Ann. Ch. et Phys.* (2) lvii. 266.
[8] *Proceedings of Boston Soc. Nat. Hist.* vi. 409.

A quantity of solution of permanganate of potash acidulated with dilute sulphuric acid, having been added to a dilute solution of chrome alum, also acidulated with sulphuric acid, retained its purple colour after having stood in the cold during twenty-four hours; at the end of this time, bits of paper were introduced in order to destroy this colour, after effecting which, the solution was tested: it contained no inconsiderable amount of chromic acid.

The foregoing experiments were all repeated, with almost absolutely identical results, with solutions prepared by dissolving chemically pure hydrated sesquioxide of chromium in dilute sulphuric acid. The formation of chromic acid in the cold may have been a little less rapid in this case than in the experiments with chrome alum; the mixture containing peroxide of lead, however, afforded an abundance of it when tested, after having stood two hours, and still more at the end of twenty-four hours. That containing peroxide of manganese also gave a fine reaction of chromic acid after standing twenty-four hours. The trial with acidulated permanganate of potash was not tested until the purple colour of the solution had disappeared; this was found to have occurred after the expiration of forty-eight hours; the solution was then yellow, and afforded the reaction of chromic acid.

(*To be continued.*)

On the Chemical Polarisation of Neutral Oxygen during the slow Combustion of Ether, by M. C. F. Schönbein.[1]

It is a fact well known for a long time that during the slow combustion of ether ozone or an analogous body is disengaged, and as it was found that during the slow combustion of phosphorus the formation of ozone was accompanied by the production of peroxide of hydrogen[2], it might be supposed that the latter would be produced during the slow combustion of ether. Experiment has shown that this is the fact.

To effect the slow combustion of ether, about a gramme of this body, and several grammes of water, are introduced into a bottle capable of holding about a couple of pints. A stoutish platinum wire twisted in a spiral form, the end of which is made red hot, is then introduced, on which the vapour of ether burns slowly at the expense of the oxygen of the air in the bottle, and a small quantity of peroxide of hydrogen is formed, which remains in solution in the water after the bottle is well shaken. To prove that such is the case, a few drops of a dilute solution of chromic acid, and a little ether, are added, which become coloured blue on agitating the mixture. This phenomenon is much more apparent if the platinum spiral be introduced ten or twelve times, the bottle being well shaken, and the air blown out every time. The ether then assumes a magnificent azure blue colour. The same tint is produced when chromic acid is added to an aqueous liquid containing peroxide of hydrogen, but in the watery solutions the colour is very fugitive, whilst in the etherial liquid it remains for some hours. The production of this blue colour at once indicates the presence of HO_2 in the liquid holding in solution the products of the slow combustion of ether. Besides this, the liquid reduces a solution of permanganic acid, peroxide of lead, the ferrates, and also the hypochlorites, with the disengagement of oxygen. It does not colour the tincture of guaiacum alone, but when some blood corpuscules, or a drop of a solution of ferrous sulphate are added, an intense blue is produced. It rapidly colours blue a mixture of dilute solutions of the red ferrocyanide and a ferric salt, which is not effected by ether alone.

All these reactions confirm the presence of HO_2 in the liquid. As the oxygenated water is formed under these conditions by the union of positive oxygen Θ with the water, we may ask what in this case becomes of the negative oxygen (ozone Θ), formed at the same time as the Θ by the polarisation of neutral oxygen. Experiments undertaken to ascertain this show that at the moment of its formation the negative oxygen Θ combines with *elayle*, a product of the transformation of ether.

When olefiant gas is introduced into a large globe containing ozone prepared with phosphorus and carefully washed, a white cloud instantly appears, and a body is formed possessing the following properties:—It produces violent irritation of the eyes, and rapidly colours blue paper imbued with starch and iodide of potassium. When water is introduced into the globe it is found to redden litmus, and gives an intense blue to starch and iodide of potassium paper. But it soon loses the latter reaction, whilst at the same time its acid property is increased. It will now be found to contain a sensible quantity of formic acid, produced by the transformation of the ozonised elayle.

The product of the slow combustion of ether then possesses properties which show at once the presence of HO_2 and ozonised elayle. It instantly colours blue the iodide of potassium and starch paper, and reddens litmus, and the acid exhibits all the characteristics of formic acid.

From these facts we may be allowed to draw the following conclusion:—During the slow combustion of ether, and under the double influence of heated platinum and the vapour of ether, neutral oxygen becomes polarised; the positive oxygen Θ combines with the elements of water and forms HO_2, whilst the negative oxygen Θ (ozone) unites, partly, at least, with elayle, to form ozonised elayle.

[1] *Journal für Prakt. Chem.* Bd. lviii. 1859.
[2] See Chemical News, p. 109.

TECHNICAL CHEMISTRY.

On the Proposed Deodorisation of the River Thames by Means of Perchloride of Iron, by William Odling, *M.B., F.R.S., Fellow of the Royal College of Physicians, Professor of Practical Chemistry at Guy's Hospital, and Officer of Health for Lambeth.*

We must, I think, all admit, that if it were possible by any reasonable expenditure, to mitigate considerably the stench proceeding from the river during hot weather, as experienced more particularly during the last two years, such an expenditure would be highly advantageous. Although there is not one tittle of evidence to show that sanitary evils have as yet resulted from the offensive state of the river, it would, I conceive, be advisable to prevent the stench on account of its being a stench, and on account of the panic which its presence would create in the minds of Parliament, the press, and the public.

During the months of June, July, and August of last year, 17,700*l.* worth of deodorising material was thrown into the Thames through the sewers; while the material used weekly, during several consecutive weeks, cost as much as 2500*l.* That the use of these materials was attended with some degree of general advantage is, I think, unquestionable, and they were certainly of local benefit. At the same time I do not estimate the effects

produced by them so highly as do some. Thus I find that during the month of June the river temperature rose from 63° to 68°, and, simultaneously, arose the river stench. The average weekly temperatures during the four weeks of July and the first week of August were respectively 69, 73, 74, 73, and 70½°. During these five weeks the deodorising operations were at their maximum; but I do not find that any decided improvement in the state of the river occurred until the second week in August, when the temperature of the river gradually fell from 69½ to 65½°, after which time the stench obviously and progressively diminished. The deodorisation was discontinued on September the 3rd, after which date the river temperature did not exceed 60°. Judging from the remarks of persons constantly on the river, I do not think that the effects produced by the deodorants were quite as decisive as has been represented. The deodorising agents chiefly employed were chloride of lime, of which 478 tons were used, and chalk lime, of which 4280 tons were used. The expenditure on the chloride of lime probably constituted about one-third of the total expenditure. It is important to recognise the fact that these two agents act on very different principles. Chloride of lime destroys putrescible matter; lime merely delays the putrefaction. I consider that the money expended on chloride of lime was well spent, or at any rate, that chloride of lime was the most likely agent that could be selected to effect an abatement of the stench. But I have great doubt whether any benefit whatever accrued from the use of lime, which is a mere retarder of putrefaction. If we could delay the putrefaction of sewage until that sewage had found its way out of the river, we might hope to effect some good with lime; but this is quite impossible during the period of the river stench. It is not two or three days, or even a week's sewage, that has any morbid effect upon the state of the river. For the cause of the stench, undoubtedly, is the large proportion of sewage matter which accumulates in that portion of the Thames oscillating twice a day between Blackwall and Battersea. There was no obvious stench experienced at Battersea at low water, or at Blackwall at high water; but each locality suffered according as it came into relation with the comparatively unchanged body of foul water which was moved to and fro by every tide. In all probability the hot weather would have been quite inoperative in causing the sewage of the Thames to become offensively putrescent, if we could then have had the same amount of dilution and scour which exists now. But during the hot weather the quantity of water daily poured into the Thames was only about five times as great as the quantity of sewage, and the proportion of sewage in the mass of river water gradually approximated to such a ratio. The body of foul river water carried up to Battersea with every flow, and carried down to Blackwall with every ebb of the tide, received its daily accession of sewage, which oscillated to and fro for an indefinite period, before it finally made its way to sea. Now the process of liming retards the process of putrefaction for two or three days only, a delay quite inoperative in effecting any alteration of the river stench. Moreover, the putrescence of limed sewage when once established is of a most disgusting character. Again, the addition of lime to the river tends to produce an increased deposit of most objectionable mud. If, during the summer drought, the liquid sewage escapes with extreme slowness, the sewage mud escapes with still greater slowness. Every ebb tide deposits its filth on the exposed banks of the river, and while the water does not acquire a temperature above 70°, that of the mud may arise to considerably above 100°; and when this sun-acted-upon-mud is washed up by the succeeding flow, we above London Bridge experience the maximum of river stench. I think it most important to avoid the use of deodorising agents which, like lime, tends to produce any considerable increase in the quantity of river mud. At Leicester and Tottenham, where the process of liming sewage was adopted with great advantage, the clarified sewage carefully separated from the deposit of mud and filth was alone allowed to mingle with the streams.

Perchloride of iron, the agent proposed to be used by the Metropolitan Board during the forthcoming summer, corresponds in its mode of action rather with lime than with chloride of lime. Its chief action consists in retarding putrefaction, though at the same time it does act to some extent as a destroyer or oxidiser of putrescible matter. Drs. Hofmann and Frankland originally recommended this agent for one specific purpose. They proposed that it should be used as a substitute for lime, in the same manner that lime had been heretofore used at the Leicester and Tottenham works. That is to say, the sewage was to be treated with perchloride of iron, and allowed to stand at rest. The clear defecated liquid was then to be run into the river, and the deposit of filth to be carried away. From their experiments there can, I think, be no doubt as to the extreme applicability of perchloride of iron for that special purpose, and to its superiority over lime in the completeness, rapidity, permanence, and economy of its action. But the above described mode of dealing with sewage, and that proposed to be carried out by the Metropolitan Board during the present year, are entirely different, and it by no means follows that an agent which is the most suitable for the one purpose should necessarily be the most suitable for the other.

In comparing perchloride of iron with lime as a material to be cast into the sewers, and thence into the river, I should say that the advantages were nearly all on the side of perchloride of iron. Measured by its immediate effect, it is certainly cheaper than lime; Drs. Hofmann and Frankland estimate it at only half the price. It delays putrefaction for a much longer period than lime. It does not necessitate the production of so large a quantity of mud, and the mud which is produced will probably be of a less putrescible character. On the other hand, the mud produced by perchloride of iron is characterised by a somewhat rapid subsidence; in other words, it is more likely to be deposited than is the mud produced by lime. Another inconvenience which will probabably follow the use of perchloride of iron will be the darkening in colour, or even the blackening of the river. If the great object of the chemical treatment of sewage is to prevent popular outcry, I think any injury to the appearance of the river will be most prejudicial to such object. The black colour of the river most certainly would not give any real occasion for public alarm, but neither does the foul smell. Yet it is quite certain an offensive colour and an offensive smell are alike exceedingly liable to create alarm.

In comparing perchloride of iron with chloride of lime, I an not at all sure that the advantages are on the side of the iron salt. Chloride of lime is an agent of well established efficacy, which has been used as a deodorant under almost every variety of circumstance.

Perchloride of iron must be regarded at present almost as an experimental deodorant, and the circumstances under which it proved successful are very different from the circumstances under which it is now proposed to be used. I am informed that perchloride of iron, used in the manner in which it is proposed to be used by the

Board of Works, was tried at Croydon, where it proved completely unsuccessful.

Messrs. Hofmann and Frankland say that one gallon of perchloride of iron defecated 15,000 gallons of sewage, and that the clarified sewage remained sweet for nine days. Whether or not it then putrefied is not stated. The particulars of their experiments are not given, but one can hardly doubt that the clarified sewage remained sweet for so long a time, on account of its containing a certain amount of iron in solution. Now, this would not be the case in using the perchloride of iron in the manner now proposed. The clarified sewage, mixing with the calcareous river water, would very soon be deprived of its dissolved iron.

With regard to the putrefaction of the deposit produced by the addition of perchloride of iron to sewage, Messrs. Hofmann and Frankland's account is not very precise. They say: — "Having thus stated the results of our experiments regarding the process of deodorisation, it remains only to draw particular attention to the importance of discharging the sewage into the river as free from mechanically suspended matter as possible. We have found that this suspended matter, when separated even from the deodorised sewage, rapidly passes, in warm weather, into a state of active putrefaction. The removal of this matter would, in a great measure, prevent the formation of any offensive deposit upon the banks of the Thames, not to speak of the improvement in the appearance of the river which would thus be secured. We are therefore of opinion that filtration should be invariably employed at the outfall of the western division, and that subsidence, if not actual filtration, should be resorted to at the two remaining outfalls." From which I can only infer that the action of the perchloride of iron was found to correspond with that of lime. It produced a clarified sewage which might innocuously be cast into the river, but that, like lime, it also produced a sludge or mud scarcely less liable to putrefaction than the undefecated sewage itself.

Messrs. Hofmann and Frankland base their calculations upon the proportion that a gallon of perchloride of iron, costing 6*d.* and six pounds of chloride of lime costing 7½*d.* will equally serve for the defecation of 15,000 gallons of sewage. As the quantity of sewage poured daily into the Thames is about 5300 times this quantity, the Board propose to use about 5000 gallons of the perchloride. Each gallon of perchloride will consequently be mixed with 15,000 gallons of sewage, or 100,000 gallons of river water. Now, the tenders for the supply of perchloride of iron have not yet been examined, but I have very great doubts whether perchloride of iron of the quality required by the Board, that is to say, containing one pound of iron and only one ounce of free muriatic acid, can be supplied for anything like the price named. On the other hand, I know that chloride of lime can be procured for 7½*d.* per six pounds, and I think it probable it might be procured for somewhat less. I think the Board would have done well to have advertised for tenders for the supply of chloride of lime as well as for chloride of iron. They would have been in a position to say which would be cheapest.

[The Doctor concludes by expressing an opinion that in the present summer there will not be that remarkable drought which aggravated the stench during the two preceding summers, and recommending the use of chloride of lime, if the necessity for a deodoriser should occur. Dr. Letheby has also expressed himself against the use of the perchloride of iron.]

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Products in the Museum, by Ed. Lankester, *M.D. F.R.S.*

Lecture II. (April 17, 1860.) *On Wool and Hair.*

I propose to-night to leave the invertebrate animals altogether, and, reserving shellfish and other creatures belonging to that group for another time, to proceed to bring before you some of the products of the higher classes — the vertebrate animals.

Now there are various ways in which we might treat this subject. We might take up these animals according to their natural history classification; but the objection to this plan is, that we should have to repeat a great deal in one class of what was said in another, so that I propose first, to take the whole group, then the appendages to their skins, then the skins, and then the organs. All animals as well as plants are covered with what is called epidermis. If we take a brush and brush our arms we shall observe a quantity of dust to fly off. If we collect that dust and put it under the microscope we shall find it to be composed of a series of cells. Now these are called epidermal cells, and the whole of the membrane which lies at the top of the skin is composed of these cells, as well as the mass of matter which lies above the true skin and which we call the epidermis. It is this part which rises when we apply a blister upon the skin, the water coming from the true skin beneath and pushing it up. Now we find that this epidermis extends throughout the whole animal kingdom, and it is not confined to animals but is found also in plants. Thus if we look on the outside of plants we shall constantly find that there is a delicate membrane on the surface composed of cells which are much more dense and firm, and lie closer together, than those which are found immediately under. This external membrane then is called the epidermis both in plants and in animals. Both plants and animals constantly have an inclination to form appendages upon the epidermis—sometimes we call them warts and sometimes we call them hairs. Short hairs we call *pilli*, and when they have little glands at the bottom containing a secretion which stings us when we touch them — we call them glandular, such as the glandular hairs of the sting of the common nettle. Now these are the epidermal organs of the plants. We find also that when the membrane is carried into the interior of the plant that it forms a softer set of organs than it does when it is on the exterior. Thus we find that it lines the interior of the apple and the orange and other plants, and (more important to us) it lines the interior of the fruit of our cotton plant and furnishes us with cotton hair. These cotton hairs under the microscope have a little twist, giving to them a permanent bend which enables us to twist them into a thread which can be woven into a fabric, and whatever importance we possess as a manufacturing nation we owe to cotton first, then to wool, then to silk, and next to leather. In our manufacturing industry we use the hairs of animals and they may be woven in the same way as the hairs of plants.

And now I wish to draw your attention to the fact that the epidermis of animals will produce hairs just in the same way as it produces hairs in plants, and not only hairs but a variety of organs which we do not recognise by the name of hairs. We should hardly call a corn on our toe a hair, and yet it is an epidermal appendage of the same character. We should hardly call the horn of the rhinoceros a hair, and yet it is formed in the same way. And in the invertebrate animals, crabs, lobsters, insects, shellfish, if you examine them you will find that this external membrane has become converted into a skeleton, and thus we call them epidermal skeletons. And if we pass from those lower to the vertebrate animals we find them producing a variety of appendages upon their skins, the object in view being the preservation of the life of the animal. Take the fish, for instance, the

most distinguishing features of the fish are its scales, and the variety and adaptation of its scales, which are joined the same as the epidermal hair of plants, and are formed of a similar series of cells. We classify fish in our natural history classification according to the form of their scales, and it is by these the philosopher is able to determine their species. Again, the feathers in birds are modifications of the same organs, and we sometimes find in the *mammalia* organs very much like feathers, as in the porcupine and hedgehog. Then we have in the mammalia animals with hoofs and horns which are also epidermal appendages. When we examine the horns we find they are an immense collocation of the hairy substances. Ruminants and pachydermatous creatures have hairs. The claws and bills of birds, our own nails, for instance, are formed like this hair. Now I want to call your attention to the way in which this hair is formed. You will recollect that there are little depressions in the skin like holes called hair follicles. Those follicles are filled naturally with an oily matter, and when the hair is formed we have little bloodvessels which supply the lower part of those follicles, and cause the cells to grow faster at the bottom, and thus an organ of this kind is pushed out. Corns are formed just in the same way. When you have a tight boot you make a pressure which causes increased nourishment of the epidermis, which results in the painful growths of which so many complain. So with warts, they are an excessive secretion of these epidermic cells.

Now the subject I want to bring before you is wool, not hair; but this wool is nothing more than a modification of hair, and we call it wool because it has a tendency to curl. We say when a man's hair curls and is crisp that he is woolly headed, and there are woolly headed races of mankind. Well, that tendency which we occasionally find in the human race is constant in certain animals, which accordingly yield this substance we call wool; and we shall find that the growth of this wool is attended with certain alterations by which it becomes useful for certain purposes for which we cannot use hair. We cannot weave human hair. We cannot felt human hair. We cannot make the warm garments with hair that we can with wool. If you put a piece of human hair under the microscope you see that the exterior is composed of scales which overlap each other so as to present an imbricated appearance. Now if you put wool under the microscope you will see that the exterior presents a serrated appearance, which is much more developed in some wools than in others. It is only after long boiling and treatment with sulphuric acid that you can get human hair to look in the same way with the scales all spread. Now it is dependant upon these woolly hairs possessing looser scales that they are of use in the arts. That the use of wool depends upon those imbrications is seen in the kinds of wool more extensively employed in the manufacture of cloth. There are several calculations of these serratures. Mr. Goss finds that the finest Saxony wool contains 2720 in a single inch. Now that Saxony wool is used for making superfine cloth, and it is a kind of wool that we never get from English sheep. Some merino wool presented to Mr. Goss showed 2400 serrations to the inch. Now we come to our own Southdown fleeces, which are known by manufacturers to be inferior to the Saxony wool, and Mr. Goss found in Southdown wool 2080 serrations to the inch. Next we come to our Leicester wool, which is still less valuable, and in this we find only 1850 of these serrations. Now that calculation has but recently been made, but it proves that those serrations have some relation to their use in the manufactures; and now that that is made out the manufacturer will know how to detect the quality of the wool by the use of the microscope. It is all very well for men to say "we can use our hands and our eyes as we have done from the time of Adam, and we do not want any of your new-fangled instruments;" but that is like a man rejecting the use of one of his eyes because his grandfather had only one eye. By the use of the microscope we can detect qualities in the wool hitherto unknown even to the practical man. These serratures then are of great importance in the history, and indeed in the manufacture of wool, and it would appear that that process which is called felting, depends entirely on those little serratures becoming entangled one in another, and thus a piece of cloth is made without weaving. You cannot too early know the distinction between the uses of the different kinds of wool. One kind is converted into what we call cloth by the felting process, and another is converted into what we call worsted, or stuff, or stockings. These are made from the hair which does not felt well, and we find that it is just in proportion to the number of these serratures that the cloth will felt well. The longer the wool the less the number of these serratures in the inch, and the shorter the wool the greater the number. All the short wools are preferred for the cloth manufacture, and all the long wools for the worsted manufacture. We have instances of the use of wool for felting, which show that the process of felting has been known almost from time immemorial. As to other hairs, those of the stoat, the mouse, the sable, the rabbit, the dog, the cat, and the hare almost all felt as well as the hairs or wool of others of the *rodentia*. And here I may remind you of the beaver hat which is becoming almost as scarce in this country as the beaver himself, for these hats are now but seldom used. However, here are some portions of the illustrations of the process of felting a hat. Here I have some beaver hair, and here is some lambs' wool which they mix with the beaver hair. Now lambs' wool will not felt, but it has the curious property of facilitating the felting of the beaver hair; hence you find that the beaver hairs are knocked together with the lambs' wool, which comes out to the surface like cream upon milk. You may see the whole process illustrated in Mr. Roberts's case in the museum. There is also a beautiful specimen of cloth in the museum, sent down to this Institution by Mr. Roberts, which consists of the hairs of the rabbit felted, so producing a beautiful piece of cloth,—a cloth which I should think is likely to be used for a variety of purposes in the arts. That is just then an instance of the fact that other hairs besides wool will felt. Now I have sometimes suspected that this property of felting is not solely due to these serrations, these imbrications so clearly developed in the wool of some animals, for I have remarked that in all the cases of the best felting hairs you always see a kind of hole or cavity in the interior, which allows the hair to yield to pressure upon a part, and thus the hair becomes reduced to a third or half of its bulk by the process of felting. I throw this out as a hint to those interested in the process. Now I come to the chemical nature of hair. I told you in the last lecture that the animal kingdom was distinguishable from the vegetable by its fabrics being generally composed of gelatine instead of cellulose; but that was a generalisation not without great exception: for in fact these hairs and that silk which I spoke of on the last occasion of our meeting are not like gelatine. When we put them into boiling water they do not dissolve, and we could not wash them if they did. The composition, however, is after all very nearly that of gelatine, and there is some difficulty in ascertaining what is truly the nature of this epidermal substance, when it assumes the form of the hair, the nail, the hoof, the quill, and of the scale. Those substances have been examined by the chemist, who has not found anything definite in them. If any of you are chemically inclined, I will put them down in symbols C.H.N.O.S.

I do not think you will make much out of that. The fact is, I have not been able to make anything of it myself, at the same time it is quite possible for some of you to understand it. We have, you see, the four organic elements, carbon, hydrogen, azote, and oxygen, and it seems probable that when these matters have been used as muscle and nerve, that a certain quantity is passed off to the skin and there it forms the epidermal organs. But during that process it combines with a quantity of sulphur (for all these substances contain sulphur), and that is how they are distinguished from the gelatine, which does not contain sulphur. That is not exactly all I can say with regard to the chemical

composition, but I have no doubt the time will come when the chemist will understand of what these epidermal appendages are formed, though the subject has not yet been successfully taken up by any chemist that I am aware of. Now I wish to speak of the sources of wool. Everybody knows we take it from a sheep. What is a sheep? Can anybody tell me the difference between a sheep and a goat? Yes, you say. Then if you can tell me in a very few words you will confer a benefit on the naturalist. You find that the wild sheep run into the wild goats. The llama, the vicugna, the guanoco, the camel, and the dromedary are so closely allied that we are puzzled to know where camel begins and where alpaca ends. So it is with the sheep — there are wild sheep. There are the *argali*, which live in certain portions of Asia, distinguishable from our sheep; and there is also the *argali* of America, the sheep which is called *ovis montani*. Then there is a sheep which inhabits the Islands of Greece. It is very certain that the old sheep which we read of in the Bible was not a descendant of that American sheep in any way. Then the question is whether it descended from the *argali* of Asia or the *musimon* of Crete or of Greece. There is considerable difficulty in getting at those lines of distinction, and we speak then of our sheep as an independent species. Now the great and individual features of our sheep have been maintained through a long period of time. The sheep we have at the present time seem to be identical with the sheep of old. The sheep of Judea seem not to have differed from the sheep of the present day, and when we read in the Bible of the tending of sheep and their management, we feel that the sheep of that day were like the sheep of the present day, that their habits were the same, their domestication was the same, and their uses were the same; for we find the man of that time eating the mutton, and using the skins for clothing until he learned to weave the wool, and then he made cloth garments. Now we have what are called breeds of sheep, and those breeds of sheep are somewhat difficult for persons not acquainted with agriculture to determine. There are, however, in the Museum a number of heads of sheep constituting a large variety which have been employed in the production of the wool in this country. We may divide them into the old mountain sheep, the early inhabitants of our island, and those more recently introduced, which are sheep of the plains. You all know the little Welsh sheep having a leg not weighing more than two or three pounds, hardly enough for a strong man's dinner. They have so small a crop of wool that it is hardly worth while shearing them, therefore they are going out of fashion. There are people from Wales who like Welsh sheep as the Scotch like Scotch sheep, and thus the kind is kept up. But there would have been no Leeds and no Bradford if there had been none other than Welsh sheep. Little sheep generally bear small fleeces. The Welsh and Irish generally yield no more than 2 lbs. and the Leicester as much as 8 lbs., and in America we have recently been informed they have a fleece of 18 lbs. The tendency in this country in the breed has been to get a large amount of wool, but at the same time you ought to know that in this country we do not produce the finest kind of wool. The long wool sheep yield a valuable produce, but it is the short wool sheep which produces the most valuable. That, however, fails to equal the short wool sheep of Germany, of America, and more especially of Australia, and all these are surpassed by the Spanish sheep. The merino sheep, originally reared in Spain, produces the finest finest quality of wool for the manufacturer. This wool is short, and covered with a sticky secretion, and we can easily see in this wool that it makes the finest quality of cloth that is worn. Hence it was that, many years ago, the attempt was made to introduce the breeds of merino into England. They succeeded to a certain extent, but our climate was too damp and not sufficiently warm to develop their produce, and I believe there is not now a single merino sheep in this country, although thousands of pounds have been spent in the attempt to breed them. Our manufacturers obtain their merino wool from Spain, but at one time the law forbade the importation and exportation of wool, and we were then confined to the produce of our own soil. It was at that time that the sheep were introduced from Spain. Spain has lost much of her prestige and much of her industry, and when one hears of the climate of Spain and the vast resources of that country, one grieves to think it is doing so little among the nations of Europe. But what has not been done by Spaniards has been done by Englishmen. A few of these merino sheep found their way to Botany Bay. I do not mean to say that any cunning sheep stealer carried away a flock of these sheep while he was paying the penalty of his malversations. At any rate they were carried there and afterwards neglected, but in spite of that they flourished and increased; and from that small beginning has arisen an enormous trade; and now our largest supply of best wools is from our colonies in Australia. We get other kinds of wool from Saxony, and Saxony wool is perhaps the best spinning wool known in the world. All German wool, however, is not so good, but we get from Germany large quantities of the finest kind for cloth. At the present time we are deriving a considerable quantity of fine wool from America, and America is carrying on its woollen manufacture from the production of its own sheep. Many parts of North America produce very fine wool. It would seem almost hopeless for the English farmer while he produces very fine mutton to compete with America, Germany, and Australia in the production of the best wool; but at the same time the mixture of breeds has presented us with very fine wool, and the day may come when we shall produce the best mutton for our tables and also produce the best wool. I have not time to speak of Chinese and Indian wool and the wool of other portions of the world. We obtain it from almost every part, but none is more remarkable than those which I have mentioned. Now I will just refer to other animals which yield us wool as well as sheep. You will find in some of the cases in this museum that the camel yields a wool which is occasionally woven by the women of the country into a kind of coarse garment. The other creatures which come in competition with the sheep are the goat, the llama, the alpaca, the vicugna, and the guanaco. The goat itself is difficult to distinguish from the sheep, but the common goat does not produce anything like the quantity of wool that the sheep does. But in certain parts of the world the goat produces very fine wool which has been manufactured into the finest garments. It yields a fleece of from 1½ to 4 lbs. of fine fleecy long hair. In 1848 it was first brought into the markets of Europe. I will just remark in passing that what we call velveteens and plushes are mixtures of cotton and wool. Silk and wool are also mixed, and these hairs of the Angora goat are particularly well adapted for this mixture. There is a goat in Cashmere which yields an exceedingly fine wool, which is employed in the manufacture of those beautiful Cashmere shawls which are such objects of desire to those who wish to appear in the most beautiful forms of dress. This goat yields a fleece of which about 30 ounces are sufficient to manufacture a shawl a yard and a half square, and the worth of the 30 ounces is 8*s.* or 9*s.* Then why do these shawls cost 600*l.* and sometimes 700*l.*? In answer to that question I will read a passage from the catalogue of this Museum. "Thirty ounces, valued at 8*s.* or 9*s.*, are all that is required in the manufacture of a shawl a yard and a half square. The immense cost of these shawls in the European market is therefore a subject of much wonder to those unacquainted with the history of their manufacture and transportation. A heavy duty is first paid upon the wool, then a further tax upon the yarn when it reaches the bazaar, and the manufactured shawl when taken to the custom house is further taxed according to the direction or caprice of the collector. If intended for the European market the shawls have yet to pass through the ordeal of still heavier exactions. They must be borne from Cashmere across the Indus to Peshawur on the frontier of Affghanistan, a journey of twenty days, upon the back of a man

the road being often impassable for camels or mules, deep precipices being crossed by suspension bridges of rope, and perpendicular rocks climbed by means of wooden ladders. At various stages of this journey taxes are exacted amounting to 36*s.* or 42*s.* in the aggregate. From Peshawur to near the confines of Europe tribute is paid at many custom houses, and the forbearance of the marauders of Affghanistan and Persia and of the Turkomanic hordes must also be purchased at a high price. The precious burden is thus conveyed to Europe over the Caucasus and through Russia, or, as is now frequent, through the Turkish provinces to Constantinople." You see our friends in Cashmere are not aware of how fully we have discussed the question of free trade, and determined that it is best for the extension of trade. You need not wonder then that those beautiful shawls manufactured from the hair of the Cashmere goat should sometimes reach a price of 600*l.* or 700*l.* before it passes the rocky portals of the valley of Cashmere.

But I now pass to a kind of animal that has only recently yielded produce for our backs, but which is likely to increase the quantity of our cloth. I allude to the alpaca, which is allied to the camel and dromedary. When Cortes conquered Mexico, and Pizarro Peru, they found the llama employed as a beast of burden. The Mexican and Peruvian government have placed an embargo upon the exportation of these creatures, so that we have only now and then seen them as curiosities in the collections of our zoological gardens. But in 1846 it appears some of the wool was carried to Bradford. I recollect a gentleman of the name of Dennison coming to the meeting of the Association for the Advancement of Science, who endeavoured to convince the association of the importance of the wool. Upon one occasion he brought six of the animals to the association, but notwithstanding all that was done the alpaca wool was neglected, and much of it was lying and spoiling in a cellar, until an enterprising gentleman, named Titus Salt, bought the whole, and succeeded in laying the foundation of one of the largest enterprises in this country, and thus conferred a blessing upon his own country as well as the countries from which the animal can be obtained. The length of this hair renders it of considerable importance for mixing with the mohair and goat's wool. I would mention that there are four of these animals very distinct in form, as may be seen in the llama, the alpaca, the vicugna, and the guanaco. The vicugna yields very fine hair, which is not very much valued, but the alpaca yields a kind which is highly prized. I have mentioned the advantage of acclimatising other animals. There is no difficulty apparently in Australia, though where they have attempted here rot has seized them, because of the tenderness of the feet. A few months ago several alpacas were secured, somehow or another, and sent over to Australia; whether they have arrived there and are flourishing, I know not, but that is an experiment which ought to be encouraged, for we know not how much it may extend our manufactures.

I will now call your attention to the manufacture of wool. This wool has to be taken from the back of the animal. Like all these other epidermal appendages, it is liable to be cast off. There is one peculiarity of this epidermis, that if creatures do not throw it off by what we call a moult, it is continually going off. We are continually moulting, but occasionally large quantities of hair come off, and this is moulting. At the same time the process is a natural process of moulting. You see it in the antlers of some creatures and the horns of others, in the hair of all the mammalia, and the feathers of birds, and the scales of fish. This wool would fall off, but men come in and prevent the falling, and the trouble of picking it up, by shearing. But there is a process first of washing. If you look at the fleeces in our museum it is always stated that it was washed on such a date, and that washing is necessary to make it available for the manufacture. At the base of those hairs a kind of soap is formed of oil and potash, which is a kind of natural soap for mixing with the impurities of the hair, and the grazier takes advantage of this soap. Sometimes various lyes are used with the addition of various substances for killing insects, but generally these processes are bad, and the only thing necessary is to take the animal and wash it in soap and water, and afterwards in clear water. The shearing takes place in the spring of the year and in the autumn. Everybody has seen the lambs after shearing, when their mammas have stared at them in their new appearance, and when it was only by their bleating that their mammas have recognised them.

Now the next process is an interesting one—assorting and stapling. The wool got from an animal is not all long or short; even the short wool sheep have some long, and the long wool sheep have some short wool.

Well, this process is a very interesting one. The persons who do it are called woolstaplers. They take the fleeces in their hands and they sort it out. There are fancy sorts, colours, cleansed, and waste, all to be stapled, and it depends upon the object of the seller how it shall be stapled.

Now, then, we take our stapled wool to the manufacturer, and now this wool is scoured or washed. It contains a good deal of dirty matters of various kinds; it contains grease, lye, animal matter, and it is exposed to various substances which take out the ammonia and oily matter, and frequently, after being scoured, it is submitted to pressure in order to dry it.

Then comes the dyeing process. It frequently occurs that the manufacturer wishes to dye in the cloth, and with his lighter and brighter colours that is always the case. After the wool has been dyed, it is submitted to a process called willying, which merely means arranging the wool so that the fibres are laid parallel to some extent; and after this is done a further process of picking is employed, and then comes this process of scribbling which is antecedent to the carding. This carding seems to be almost as important as the felting, for it is this carding which breaks up the wool, and gives it a tendency to curl. If you look at a piece of felted cloth the pieces of wool are curled, and you cannot get the curl out of them; and you find that the carding which breaks it up is almost as important as the felting. Then the spinning takes place, and the reeling and warping, and then we have another process of scouring, for they have added oil, and during the process of spinning they cause the thread to pass through size, so that the threads may lie close together. And now you have to add potash to get rid of the oil, and soap and water to get rid of the size. Then after the weaving you have the fulling—the fulling is effected by enormous wooden hammers which are allowed to drop on to the cloth. By this hammering the cloth is reduced to a condition in which its strength is fully developed. Whilst it has been unfulled it has been weak and easily torn, but now it is not easily torn. After it has been fulled it is again scoured, and then it is submitted to a process which is called teazling, or cleaning, or brushing, or raising. This process consists of applying the little bodies which are called teazles. The object of this teazling is to bring up the loose particles of the wool, in order that they may be sheared or cut off, to give the cloth the fine appearance it assumes. Now look at the teazle. Man has invented nothing which can take its place. This teazle is remarkable for producing its epidermis with spiny bracts, the end of which curls downwards; and if you get a teazle in the road at any time and brush it on your hand you will feel the effect; and then if you pass it along your cloth you will find that it will rub it up, and raise the surface. Now various instruments have been employed: a series of pieces of wire have been run into a leather back, but nothing has superseded the teazle. We import these teazles in large quantities from France and various portions of Europe. After the shearing and cropping has been gone through, then comes the pressing and rolling up, and doubling up, and pressing and packing.

If time had permitted, I might have said something of our enormous woollen trade. There is no other, except the cotton, which is greater. For worsted you take a hair, not for the purpose of felting it or of carding it, for you neither

card nor felt in the worsted manufacture, but we take a wool that is long. The very first process is not to imitate those serratures, but to fold them down softly and bring them down as closely as you can by means of oil and an iron comb, and this is called combing, which is almost the same process as with the cotton. You have then the same process of cleaning and making yarn which are run into fine threads, and these threads are woven together in the ordinary manner like cotton; the roving takes place in just the same way, and the particles are twisted together. We distinguish between woollen and worsted manufactures. Woollen consists of broad cloths, carpets, blankets and serges, so that you see how important is the manufacture. The worsted is no less important. Stuffs, bombazines, camlets and shawls, are all instances of the worsted manufactures. The woollen produces a warm and heavy garment, while the worsted produces a light and loose as well as a warm garment.

Thus you see the value of the culture of the animals around us. In course of time we may find, if we learn our lesson rightly, that there is nothing created for us in vain, and that whatever God has made He has created for the use and benefit of man.

SOCIETY OF ARTS, *Wednesday*, 25 *April* 1860.

EDWIN LANKESTER, *Esq., M. D. in the Chair.*

† DR. JOHN DAUGLISH read a paper to this meeting of the Society describing in detail his *New System of Bread Manufacture*. After a few introductory remarks, he said:—

"Bread-making essentially consists in completely incorporating flour, water, salt, and carbonic acid with each other, in such a manner as that they shall form a tenacious, elastic, and bulky mass, in which the aeriform constituent bears to the solid a proportion of about three or four to one, and which, on being placed in the oven and thoroughly baked, shall swell to about double the proportion.

"Until very lately the mixing and incorporating of the solid constituents have been performed by the hands and arms, sometimes assisted by the feet; but during the last few years, especially in France, there have been some very ingenious kneading and mixing machines introduced for this purpose, that of M. Boland being of especial merit. The mechanical part of bread making is very easy of accomplishment, and in results, like all mechanical processes, can always be relied upon with certainty. It is the chemical part out of which all the difficulties and uncertainties arise, and which has presented the only obstacle in the way of bread manufacture participating in that marvellous progress of the industrial arts which is the distinguishing feature of the present age—and of its taking that position as a manufacturing institution of the country which its magnitnde and importance deserve.

"The chemical changes within the substance of the dough which it is the object of the baker to effect, are those which shall result in the alcoholic fermentation of transformed starch or glucose, whereby these bodies are broken up into alcohol and carbonic acid, which latter is the only product desired, but which cannot be obtained without the previous transformation or degradation, more or less, of the constituents of the flour. It is not necessary for me here to give an account of all those complex changes which constitute the chemistry of bread making, as this has already been so ably done by Dr. Odling, but I will simply mention those which are the source of so much uncertainty and variation in the preparation of bread.

"In the first operation of bread-making—the preparation of the sponge—the baker mixes up together, into a soup-like paste, flour, warm water, and yeast or leaven; this he allows to stand for some hours, during which active fermentation is set up, and bubbles of carbonic acid are rapidly formed, and rise to the surface. In fact the prolonged action of warmth and moisture combined with that of the yeast or leaven, change the whole body of paste into a ferment sufficient to effect a very large quantity of flour when incorporated with it. You will hence perceive that by thus forming a sponge. the necessity to use large quantities of yeast is avoided on the one hand, and on the other the length of time that would otherwise be required for putting the whole of the flour into a state of active fermentation is considerably shortened, and the deterioration of the flour, which is caused by the prolonged action of warmth and moisture, proportionally lessened.

"The advantages thus obtained will be more readily seen when it is remembered that the true alcoholic fermentation is only the later stage of what is termed the panary fermentation. It is that stage wherein the metamorphic nitrogenous body or yeast acts directly upon glucose or grape sugar, breaking it up into alcohol and carbonic acid. But before this can take place, since in sound flour there is very little, not more than a trace, of sugar, and the gluten is nearly or wholly introduced, certain portions of the gluten and starch must have passed through the necessary changes for the alcoholic fermentation to act. This then is done in the sponge, when the mixture of flour, yeast, and warm water is made, and the temperature is maintained at about 48° Fahr. The gluten, by virtue of its own spontaneous tendency to change under these conditions, assisted by the yeast, becomes metamorphic, and immediately acts upon the starch, changing it into dextrine and grape sugar, whilst at the same time the yeast plant is propagated at the expense of a small portion of the changed gluten, &c. Thus we have in the sponge all the materials, the dextrine, and glucose, the diastase and the yeast, in a state ready to pass into active alcoholic fermentation, and to give off the necessary bubbles of carbonic acid immediately their complete incorporation with the flour is effected, so that the least possible injury to the bulk of the flour is secured.

"But when unsound flour is used in bread making, we have a very different state of things. Unsound flour is flour in which some of the changes on which panary fermentation depends have taken place to a greater or smaller extent, which are somewhat analogous to malting. The gluten has already become metamorphic, and the starch partially or wholly changed into dextrine or glucose. The gluten has lost more or less of its elasticity, and is ready immediately on the application of warmth and moisture, not only to pass rapidly into a state of solution, as Liebig has termed it, but to act with the greatest energy on the partially changed starch, completing its alteration into glucose, so that a running sticky mass results from the attempt at fermentation. Such a state of things, however, may be and is frequently brought about, even when good sound flour is used, either by inexperienced persons, who do not understand the management of fermentation and the length of time and the temperature necessary, or by peculiar states of, and changes in, the atmosphere, by which the fermentive operations are so rapidly hastened in the earlier stages as to become almost or quite unmanageable.

"Between perfectly sound flour and that which runs in the manner above referred to, on the application of a ferment there are indefinite shades of variety; and between the temperature and the state of atmosphere least liable to produce derangement and that which is most, there are also indefinite varieties. Now it is these liabilities to derangements and irregularities that have rendered the preparation of bread so precarious, and which, going along with the absolute necessity to have the article ready always at the same hour of the day—an article which, in the event of its spoiling, cannot be reprepared under eight to twelve hours—have raised an effectual barrier to its becoming an extensive manufacture in large establishments, employing large capital, and deriving the peculiar profits arising out of the division of labour.

"Having thus pointed out the distinctive features of the ordinary process for obtaining the complete incorporation of the essential materials of spongy bread, I will proceed to describe the process which it is proposed to substitute for it.

"It essentially consists, as I have said, in doing away entirely with fermentation, and with all those chemical changes in the constituents of the flour which are consequent upon it; and having obtained the necessary carbonic acid independently of, and separate from, the flour, incorporating the materials, including the carbonic acid, wholly by mechanical means, so as to secure the bulky elastic mass which is capable of being baked into light spongy bread.

"When wheaten flour, salt, and water are thoroughly incorporated in due proportions, we have a heavy, soft, tenacious substance, called dough or paste, the tenacity of which is wholly dependent on the mechanical condition or properties of the gluten of the flour, the starch, when in a sound state, possessing of itself no cohesive properties whatever, which is easily demonstrated by kneading a mass of dough carefully in a small stream of water, when the starch granules will be carried away by the water, and the gluten will remain behind in a tough, tenacious, semi-transparent mass. The process of kneading or incorporation, then, consists in mixing the materials together in such a manner as that the gluten, becoming well saturated with water, shall form a soft adhesive mass, as a matrix, in which are embedded and bound together the minute particles of starch, and if the kneading is carried on in a very thorough manner, and for a prolonged period, the dough becomes tough by the particles of gluten being driven close together, and forming a kind of sticky coat or shell around the particles of starch which thus adhere firmly together. When this mass is obtained, the point afterwards to be effected is the liberation of minute bubbles of gas within each sticky coat, surrounding each granule of starch.

"We have seen that in the ordinary process of bread making by fermentation, the carbonic acid, which is the agent of distension, is obtained from the decomposition of the starch or glucose, by the action of a ferment, which being thoroughly incorporated along with the other materials, into the dough or paste, is thus brought into contact with the starch and with the gluten with which the starch is surrounded. It is easy, therefore, to understand how, when a mass of dough thus constituted is left for a time in a temperature suitable for the fermentive change, the minute particles of starch, each imprisoned in a covering of gluten, is made the centre of a distinct chemical action, and yields up its bubbles of carbonic acid to distend its gluten coat, and how, by the aggregation of such particles, a mass of spongy dough is formed, and how, also, when the materials have not been thoroughly incorporated, and the action of the ferment is not uniform, or when the gluten is not of a firm yet elastic quality, the generation of the gas will be unequal — the minute bubbles will be burst into large ones, and the texture of the dough be impaired accordingly, rendered as it is termed 'full of eyes'—instead of being dispersed in minute bubbles, as numerous, or nearly so, as the particles of starch from which it is given off. In the new process, as the gas is not given off by the particles of starch within the gluten coat, it has to be obtained from another source within the mass of dough, in order that the minute spongy texture may be secured, and this source is the water with which the gluten which envelopes the starch is saturated, and which is held, as it were, by capillary attraction also, around the particles of starch.

"It has been long known to chemists that water will absorb its own bulk of carbonic acid, whatever the density, with great readiness when agitated with it; that is to say, supposing you placed water in a closed vessel along with carbonic acid—in a bottle for instance—filling it half with water and the other half with the gas, then cork it up; if the water and the gas be pure, and both at a temperature of 62° Fahr. and at the atmospheric pressure of 30 inches of mercury, when the bottle is thoroughly agitated, the gas will be immediately diffused through, or absorbed by, the water, until there is an exact balance between the quantity of gas held in solution by each cubic foot of water and that contained in each cubic inch of space within the bottle not occupied by the water; so that, supposing the bottle at the commencement of the experiment to have been exactly filled, half with water and half with gas—after complete agitation the barometric pressure within the bottle will have fallen to 15 inches of mercury. This law of absorption is persistent at all pressures, so that by increasing the density of the gas, the quantity absorbed by the water will be increased in an equal ratio, and so long as the water is retained under the pressure due to the density, so long will it hold the gas in solution, but whenever it is released from the pressure the gas will escape with effervescence, a familiar example of which is that of a bottle of soda water when the cork is withdrawn.

"It will now be apparent that if water, holding in solution the necessary quantity of carbonic acid gas, could be used to incorporate with flour, &c. in the preparation of dough, without any of the gas being allowed to escape from it until after the paste is fully formed, but then allowed to escape, it would cause the formation of the necessary minute bubbles of gas, which would distend the dough into a perfect sponge, even more perfect than that which is obtained by fermentation, since every atom of water would yield its atoms of gas, not only between the particles of starch and their gluten coat, but also within the substance of the coat itself, rendering that porous.

"Now, since the water will retain the gas in solution so long as it remains in an atmosphere of the necessary density, it is evident that if the materials of which the dough is to be formed can be brought together in a closed apparatus in an atmosphere superior in density to that at which the water has been saturated, and then thoroughly incorporated, the gas will remain in the water during the incorporation, and until such time as the dough is released from the pressure, but that directly it is released from the pressure due to such density, the gas will escape from the water, and in so doing will distend the dough into a perfect spongy mass. This, then, is the new process of bread-making."

Dr. Dauglish did not give more than an outline of the mechanical part of his process, but our readers will obtain a general knowledge of the *modus operandi* from the following description:—

"The apparatus essentially consists of a gas holder and a generator, similar in construction and principle to, but larger in size than, what are used by the makers of aërated waters; of pumps, suitable for pumping elastic fluids, and of a mixing vessel, and of a water vessel in connection, both made so that they can be tightly closed to sustain an internal pressure of from 100 to 200 lbs. on the square inch. The mixing vessel is supplied with flour through a shoot, passing from the floor above, and the water vessel with water, through a pipe from a cistern at the top of the building.

"The mixer is capable of being closed perfectly tight, and opened, by means of a proper mechanical contrivance, with the greatest facility, by one man in a few seconds.

"The order of working, and the time required for making a sack of flour of 208 lbs. into dough is as follows:—

"Opening lid of mixer and fitting within the neck the end of flour shoot, and turning water cock to fill water vessel	1 minute.
Passing from top of machine to floor above and shooting down a sack of flour	3 "
Returning, closing water cock, removing end of shoot, and closing mixer	2 "
Withdrawing atmospheric air from mixer	3 "
Pumping gas through water into mixer, &c.	10 "
Mixing	7 "
Total	26 minutes.

"At the end of which time the dough is ready to be drawn into loaves, from a nozzle or mouth, through which it is forced by the pressure within the mixer, and as it expands or rises in the act of leaving the mouth, it is ready to be baked immediately. One boy is capable of pulling the dough from one sack of flour into loaves in fifteen minutes, as fast as they can be weighed and placed in the oven.

"Thus in the short space of 26 minutes, which is subject to no variation, the baker can always rely upon having his dough ready for the oven, and this with a certainty, when the labour is well organised, which is nearly mathematical.

"Hence this process at once removes all the obstacles which have hitherto rendered a perfect system of machine bread manufacture an impossibility, which obstacles I will definitely state as follows:—

"1. The length of time (from eight to twelve hours) required by the process of fermentation to prepare dough for the oven, and the great space required for storing the masses of dough whilst undergoing the process.

"2. The uncertainty of its results, and the many vicissitudes arising from susceptibility to delicate influences.

"3. The degradation or spoiling of the flour produced by fermentation, which is equal to a money value of three to six shillings per sack.

"4. The necessity for the use of alum with poor flours, and the temptation to use it with all.

"In comparison with the above, the new process shows:—

"1. It reduces the time necessary for the preparation of the dough from eight to twelve hours to less than thirty minutes, and requires no space whatever for the storeage or keeping of dough larger than the mixers themselves.

"2. The results are absolutely certain and uniform.

"3. No sponge or degradation of flour taking place, the quality of the bread produced is equal to that made by the old process from a flour three to six shillings per sack dearer.

"4. As no change in the flour takes place, against the evils of which alum has hitherto been used, there is no gain whatever by the use of alum. Indeed, alum is absolutely prejudicial, by destroying the cohesive properties of the gluten. Even flour which is made from wheat harvested in bad weather makes a most delicious bread without any solution of alum."

We omit some observations upon the state of the baking trade in this country, as our space is limited, and pass on to the concluding portions of the paper. Various processes for the improvement of bread manufacture were noticed by the Lecturer, who named specially that of Mege-Mouries, for the utilisation of nutritious substances in the bran, which are ordinarily wasted. The chief of these is a nitrogenous body somewhat resembling glutine, but differing from it in many of its properties, which the discoverer named *cerealine*. To our mind it appears questionable if the so-called cerealine is not a modified form of diastase. Dr. Dauglish, however, treated cerealine at considerable length, being of opinion that it plays an important part during the processes of deglutition and digestion, when assisted by ptyaline and pepsine in the animal economy. As is perhaps very natural, the Doctor somewhat over estimated the advantages to be derived from the use of his bread, as according to him appetites and muscular strength will ever increase under its influence, while dyspepsia will disappear as if by magic, and speedily become a thing known only to history. Nevertheless we can bear out many of his assertions from our own experiences, as we have made a point of examining the patent bread, and find it of a light, even structure, possessing the sweet and wholesome flavour of "home-made bread" in an eminent degree, without any of that mawkishness which causes the latter so frequently to pall upon the taste.

The Chairman pointed out the points in Dr. Dauglish's paper most suitable for discussion, and

Dr. Letheby said that the opinions expressed by Dr. Dauglish were utterly opposed to the sound principles of dietetics; the mere vesiculation of flour and water was not the object in view in the formation of a loaf, and he contended that unfermented would be liable to produce gastric derangement if persevered with for any time. He considered that the use of alum in bread was still a moot question, and indeed the whole of his experiences were in direct opposition to those of the author of the paper.

Mr. Heywood and Mr. Morrison both considered the new bread more wholesome and digestible than the ordinary kind.

Dr. Waller Lewis supported the views of Dr. Dauglish, and considered that all other results beyond the vesiculation of the bread were superfluous. The new bread had met with universal favour.

Mr. Lobb differed entirely from Dr. Letheby on the action of yeast upon starch, which he denied was rendered more digestible by the former. A dyspeptic stomach was the best judge of the quality of bread, and he stated, from personal experience, that the new process gave the most wholesome results. He had not tasted fermented bread for four years, except when he did so with much pain and dyspepsia. To some, he said, fermented bread was all but poisonous.

Dr. Odling thought the concluding remark of the last speaker simply ridiculous. He considered Dr. Dauglish's equally good with the best fermented bread, but did not think the effects of alum in small quantities prejudicial. He had compared Dr. Dauglish's bread with that of Mr. Bouthron, without finding a difference of more than one or two per cent. in the amount of altered starch. He believed the temperature incurred during baking would render cerealine and diastase unavailable.

Mr. Wilson regretted that the new bread was more expensive than the common, costing 8½*d.* instead of 5*d.* or 6*d.*

Dr. Gibbon thought the bread was like distilled water, perfectly pure, but very insipid.

After some remarks by Dr. Guy, and several other gentlemen, Dr. Dauglish briefly replied upon the discussion, and the chairman then proposed the usual vote of thanks. He would not detain the meeting further at that late hour, but wished to correct an assertion of Dr. Letheby's, viz. that mankind had partaken of fermented bread from the commencement of history. That was incorrect; the larger portion of the human race fed upon unfermented bread. He thought Dr. Dauglish had made out a good case, and he (Dr. Lankester) was in favour of the new bread.

A vote of thanks was then passed to Dr. Dauglish. †

The members of the Society of Arts held their first *conversazione*, this session, on the evening of Saturday, the 28th April, at the Society's house, Adelphi. The exhibition of inventions was thrown open, where the various improvements in science and art occupied the attention of the company present. In the large room a collection of pictures by the late Sir William Ross, R.A.,[1] decorated the walls, and were greatly and deservedly admired; the smaller portraits of the various branches of our royal family, for harmony of colouring and exquisite delicacy of delineation have indeed seldom been equalled in modern times. A large number of microscopes, by Mr. Baker, of Holborn, were arranged on tables, showing many beautiful specimens of a miscellaneous character. A fine series of dissolving views, taken in Egypt, Nubia, &c. were exhibited at intervals during the evening, and afforded both interest and instruction.

Refreshments were served in the library.

NOTICES OF PATENTS.

Manufacture of Artificial Fuel. Eugene de Bassano.

Every chemist at all conversant with patent literature knows the general character of artificial fuel patents. We can only say that the one before us partakes largely of that general character. It consists in "improvements in the manufacture of artificial fuel, commonly called patent fuel, and consists in the composition of a fatty pitch, to be used in and for such manufacture; said pitch being composed of about 90 parts of the common brown resin of commerce, or other crude or waste resinous substances possessing similar properties thereto, but free from bad smell, and containing in the quantity used 90 parts of resinous basis contained in various refuse materials or matters, such as may be obtained from woollen fabrics,

[1] Now open to the public on payment of one shilling.

tallow, margaric acid, stearic acid, mineral oils, and other cheap or inferior qualities of oil, and all other bodies or matters possessing the properties, either when mixed together, or separately in themselves, of producing the largest quantity of hydrocarburate" (? hydrocarbons); "and at the same time of at least from two or three parts out of every 100 parts of matters possessing the property of perfect saponification, observing that when the above fatty matters and oils are used other than those above mentioned, but possessing the same nature thereas, but not equally saponificacious (*sic*), in such cases I vary the quantity thereof to be employed in proportion to their property of saponification and of production of hydrocarburate. I reserve to myself the right to use ordinary coal tar, or pitch, or even acid (by preference muriatic acid) in the manufacture of artificial fuel, when the proportion of hydrocarburet and saponificacious matters which they contain is such as will not cause the emission of noxious effluvia during the combustion of the fuel prepared therewith." Monsieur de Bassano probably drew up his own specification, if he did not, his patent agent might, we think, have studied English and chemistry to better advantage.

Use of Offal of Slaughtered Animals for Producing Soap. HENRY DAVIES.

THE specification of this patent is a delightful specimen of bad syntax, bad spelling, and bad chemistry. In the provisional specification the patentee uses chromate of potash and "allum" to bleach and deodorise the offal. In the final specification he employs chloride of lime as a deodoriser. The final specification is such a curiosity of patent literature, that we shall quote the first part of it, confessing our inability to judge of its merits as a manufacturing process until we see some of the soap "which are prepared according to it," as the patentee would say.

"I take the cleansed offals of slaughtered animals, and to about 60 lbs. of these offals, put into a tub, I add two gallons of clear lime water (about one pound of unslacked lime to each gallon of water)." [N.B.—Lime requires about 750 times its weight of water to dissolve it, so one pound of lime would, if pure, require about 75 gallons of water to make a clear solution.] "Also one pound of alum dissolved in hot water. The contents of the tub are well stirred for about forty minutes, until the offals are bleached, when the offals are washed in clear water, and allowed to drain for a short time. The offals are then put into a pan with about one gallon of liquid caustic soda (16 degrees), together with about one gallon of water in which one pound of chloride of lime has been dissolved, which are boiled down to a fatty matter by dry steam or a moderate fire heat; the boiling throws off the amonia (*sic*), and divests it of the impurities until it is fit for use."

Manufacture of Beer, Ale, Porter, and Spirits. PATRICK ROBERTSON.

THIS patent consists in employing a hydro-extractor to separate yeast from beer, ale, &c. The patentee also claims the separation, by this method, of wash from yeast which has been produced by the fermentation of waste from which spirit is to be distilled. He also claims the separation of wort from boiled hops by the aid of the same machine. Compare James King's patent for the separation of the solid parts of worts, wash, &c. from the liquid portion. King's patent is dated 26th July 1859, and sealed 25th January 1860, and Robertson's patent is dated 28th July 1859, and sealed 22nd November 1859. These gentlemen are not unlikely to come into collision.

Treatment of the Products of Distillation. JAMES KING.

UNDER this exceedingly vague title is comprised a patent for separating, by centrifugal force, the solid parts of worts, wash, spent wash, &c. from the liquid portion. The inventor employs for the purpose the well known machine so much used in dye works, and called a hydro-extractor. We can see numerous uses to which this machine can be applied in nitrogen up the products of the distillation of coals, shales, and native bitumens.

Preparations of Peat. W. H. BUCKLAND.

ANOTHER peat patent! Mr. Buckland's idea is to convert peat either into fuel or into cakes, which, by "cutting, carving, pressing, moulding, or embossing" may be made into useful or ornamental articles. He takes fresh peat and agitates it with water; by this means two products are obtained, one consisting chiefly of fibres, and the other the fine pulverulent decomposed portion of the peat. The watery fluid is run on to sieves, which retain the fibres and allow the powder to pass through with the water into vessels where, on repose, the suspended matters sink to the bottom. The fluid may then be run off, and the soft mass, when it has acquired sufficient solidity, can be moulded into any required form. The articles are to be dried in sheds. The patentee states that, when perfectly dry, the material obtained by this process is sufficiently hard to be turned in a lathe. This is certainly a most curious fact, and one which could scarcely have been expected. The prepared peat may also be moulded into bricks for fuel.

This patent contains more novelty than peat patents generally. We should much like to see some article prepared by the process.

CORRESPONDENCE.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

On some Antimonial Combinations.—M. Schneider[1] has found that boiling chloride of antimony dissolves the sulphide when in fine powder, and without the disengagement of sulphuretted hydrogen when the chloride is free from hydrochloric acid. Fourteen or fifteen parts of the chloride are necessary to dissolve one part of the sulphide. On cooling, the solution becomes a crystalline mass, which is seen to consist of rhomboidal prisms.

The new body is very deliquescent, and water decomposes it, with the deposit of a bright yellow powder. By heating it for a long time, it is split up into chloride of antimony, which is volatilised and the black sulphide which remains behind. Analyses have led to the formula Sb_4SCl_{11}, or $SbSCl_2.3SbCl_3$.

The preceding body, treated with an excess of absolute alcohol, produces an abundant orange-yellow amorphous precipitate, which, washed with alcohol and protected from the air, has a composition which answers to the formula $SbCl\,S_2.3\,SbS_3$. The alcohol at the same time dissolves a good deal of chloride of antimony and a little sulphide.

Weak hydrochloric acid changes the chlorosulphide after some days into sulphur which deposits, and chloride of antimony which is dissolved. Boiling concentrated hydrochloric acid decomposes it, with the disengagement of sulphuretted hydrogen.

Analogous bodies seem to be produced when acid solutions of the perchloride of antimony are precipitated by sulphuretted hydrogen.

Oxide of antimony also dissolves in the boiling chloride, and gives on cooling a grey pearly crystalline mass, which appears to be the compound $SbOCl_2.3SbCl_3$. Absolute alcohol decomposes this, producing the oxychloride $SbOCl_23SbO_3$, which is the powder of algaroth.

Bibasic Sulphate of Copper.—M. Rouher[2] says that a bibasic sulphate of copper is formed when the neutral sulphate is exposed for several hours to a dull red heat in a covered platinum crucible. It is an orange-yellow amor-

[1] *Pogg. Ann. der Phys. u. Chem.* Bd. cviii. s. 407.
[2] *Comptes-Rendus*, t. l. p. 500.

phous body. To avoid the decomposition of the bibasic sulphate, it is best to use crystals of sulphate which will only touch the sides of the crucible with a small part of their surface. Towards the end of the operation the crucible must be uncovered now and then to allow of the escape of the vapours of sulphuric acid. The bibasic sulphate is not altered in dry air, but when exposed to the free air it slowly attracts moisture, and becomes a green mass, which is a mixture of the neutral sulphate and hydrated tribasic sulphate.

Boiling water decomposes the bibasic sulphate, and converts it into 1 equivalent of neutral sulphate and 1 equivalent of tribasic sulphate, containing 2 equivalents of water.

M. Rouher has further studied the products obtained when the bibasic sulphate is added to cold water. If the two are stirred together so as to avoid any heating of the mass, and the liquid is filtered as soon as it acquires an uniform green tint, the insoluble salt formed is a trihydrated quadribasic sulphate, and the solution contains neutral sulphate. If, however, the bibasic sulphate and the water are simply placed together, a considerable elevation of temperature takes place, and the quadribasic sulphate first formed passes in part into the state of tribasic sulphate.

II. ORGANIC CHEMISTRY.

Transformation of Lactic into Propionic Acid. Lautemann[4] has succeeded in effecting this change by exposing a concentrated solution of lactic acid diluted with half its volume of water, and properly cooled, to a current of hydriodic gas. Iodine is separated, and when no more gas is absorbed the liquid is placed in a tube, sealed, and heated for some time to 140° C. The liquid then contains a good deal of free iodine. It is now filtered, neutralised with potash, and distilled with dilute sulphuric acid. The volatile product contains propionic acid, iodine, and hydriodic acid; it is agitated with an excess of carbonate of silver, and filtered boiling; on cooling the solution deposits propionate of silver.

The same transformation is effected in a much simpler manner by slightly heating aqueous lactic acid with an equal weight of iodide of phosphorus.

Action of the Galvanic Current on Lactic and Succinic Acids.—Kolbe[5] has found that lactic acid combined with potash behaves under the influence of a galvanic current just as with various oxidising agents: it decomposes into aldehyde and carbonic acid.

Succinate of soda gives at the positive pole carbonic acid and oxide of methyl.

Preparation of Iodide of Ethyl. — Lautemann[6] introduces 500 grammes of iodine and as much absolute alcohol into a large tabulated retort, and then places it in a vessel of cold water. He now adds very slowly fragments of phosphorus previously washed with alcohol. A lively effervescence accompanied with some elevation of temperature at first takes place, so that care must be taken not to add too much phosphorus at a time: but the reaction soon moderates, and enough phosphorus to make up 50 grammes can be added without inconvenience. The retort can now be adapted to the refrigerator, and placed over the fire. When the distilled product no longer becomes turbid in contact with water, it is shaken first with an alkaline solution and then with water; it is afterwards dehydrated by means of chloride of calcium and rectified.

The 500 grammes of iodine give from 562 to 574 grammes of hydriodic ether, that is from 91 to 93 per cent. Theory requires 614. The brown residuum in the retort is free from iodine.

III. ANALYTICAL CHEMISTRY.

Estimation of Phosphoric Acid by Molybdate of Ammonia. — Lipowitz points out[7] that in the method generally adopted for estimating phosphoric acid by means of molybdate of ammonia, it is rare to obtain results which agree. The molybdate, he says, even when diluted, is decomposed by the mineral acids, and consequently the precipitate contains an excess of molybdic acid. Besides this, boiling also occasions a precipitation of molybdic acid, which increases the error. It is necessary, therefore, to employ in these estimations an acidulated solution of molybdate of ammonia, which is neither precipitated on the addition of water, nor by an acid, nor on boiling. Such a solution, he says, is obtained by dissolving at a gentle heat 2 parts of pure molybdic acid, and 1 part of tartaric acid in 15 parts of water, and afterwards adding 10 parts of ammonia, sp. gr. 0·97, and 15 parts of nitric acid. The whole is heated to ebullition in a porcelain basin, whereupon about $\frac{1}{10}$th of the molybdic acid is deposited, which is separated by filtration.

In employing the above solution, the quantity of it thought necessary is placed in a capsule, and heated to boiling, and then the liquid containing the phosphoric acid is added. The precipitate is washed with water, acidulated with $\frac{1}{50}$th of nitric acid, and the filter is dried at 80° or 90° Fahr. between folds of blotting paper, or better still, over sulphuric acid.

[4] *Annal. der Chem. u. Pharm.* Bd. cxiii. s. 219
[5] *Ibid.* 240. [6] *Ibid.* 241.
[7] *Pogg. Annal. der Physic u. Chem.* Bd. cix. s. 135.

LABORATORY MEMORANDA.

Crystals in Alcoholic Solution of Soap. — Having frequently occasion to dissolve soap in strong alcohol, I often set aside the flask in which the operation has been performed for a few days, with the cold "jelly" of soap and alcohol in it. On looking at one of these, after the lapse of a week, I was considerably astonished to find that a number of stellate bunches of crystals of a light yellow colour were forming, and that the contents of the flask were becoming liquid. I allowed the flask to remain corked and undisturbed for a few months, and repeated the experiment with other soaps, but invariably with the same result, viz. that after a day or so the crystals began to appear, but after the lapse of a month they were considerably longer and larger, and instead of a "jelly," as at first, the flask contained a liquid as thin and mobile as the alcohol itself, though slightly coloured yellow. If you, or any of your numerous readers, could furnish me with a clue to the probable composition of these crystals, you would confer a favour on—*W. L. C.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Yokels.—To make the chemical weather-glass you must first dissolve 2½ drams of camphor in 11 drams of rectified spirit; and then 38 grains each of nitrate of potash and sal ammoniac in 9 drams of water. Mix the two solutions and place them in a long eau de Cologne bottle or tube and carefully seal it over.

J. G. F. R.—Parrish gives the following form for a compound fluid extract of Buchu.

Take of Buchu in coarse powder 12 oz.
Alcohol . . . 3 pints
Water . . . 6 pints or q.s.

Percolate the leaves with some of the alcohol and then with the remainder mixed with the water. Evaporate the resulting liquid to 3 pints and to this add sugar 2½ lbs. Continue the heat until the sugar is dissolved, and after removing from the fire add —

Oil of Cubebs,
Oil of Juniper, of each 1 dram,
Spirit of Nitric ether, 12 fluid ounces,

previously mixed, and stir the whole together.

H. P. Leighton.—Make it into superphosphate for manure.

H. H.—Ex-chemicus.—A. K.—A Subscriber—Received. Answers next week.

Books received.—Report on the Practicability and probable Efficacy of the proposed Plan for deodorising the Sewage of London by means of Perchloride of Iron, by H. Letheby, M.B. M.A. Ph.D. &c. &c. Report on the Sanitary Condition of the City of London for the year 1858—1859, by H. Letheby, M.B. &c. &c. Medical Officer of Health for the City of London. Pharmaceutical Journal, May. Notes on the Dispatch of Troops by Sea, by J. Kirwan, Esq. L.R.C.S.I. Reports of Experiments with Different Manures on Permanent Meadow Land (with Tabular Appendix), by J. B. Lawes, F.R.S. F.C.S. and Dr. J. H. Gilbert, F.C.S.

*** All *Editorial Communications* are to be addressed to Mr. CROOKES, and *Advertisements* and *Business* communications to the PUBLISHER, at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Detection of Iron in Presence of Chromium, by F. H. STORER.

(*Continued from* p. 254.)

SESQUIOXIDE of chromium, dissolved in dilute nitric acid, is also converted into chromic acid when the solution is boiled with peroxide of lead, with peroxide of manganese, or with a solution of permanganate of potash acidified with dilute nitric acid; minium produced the same result, though somewhat more slowly. This action is much less rapid in the cold; the sample tested with permanganate of potash contained chromic acid after having stood during twenty-four hours; the solution to which peroxide of lead had been added assumed a decided yellow colour, and afforded the reaction of chromic acid after standing three or four days; but the portion which had been mixed with black oxide of manganese gave no indication of chromic acid when examined at the end of the fifth day.

When dilute chlorhydric acid is used, instead of the sulphuric or nitric acids of the preceding experiments, similar results are obtained, at least with peroxide of manganese and with solution of chameleon mineral, both in the cold and when heated. With peroxide of lead, however, the results are less satisfactory. I have not been able to obtain any decisive indication of the formation of chromic acid in this experiment, but at the same time am not sure that minute traces of it may not have been present. The conversion of the peroxide into chloride of lead apparently interferes with the production of chromic acid.

In concentrated sulphuric acid sesquioxide of chromium is evidently slowly converted into chromic acid by the action of peroxide of lead, even in the cold, since the solution becomes yellow after standing eighteen or twenty-four hours. This action is very rapid if the mixture be heated, a fine yellow solution being obtained at once. I have, nevertheless, found it somewhat difficult to prove the presence of chromic acid in this solution, since it appears to be decomposed when diluted with water.

With peroxide of manganese, a yellowish solution is also readily obtained by boiling. In the cold, no reaction could be perceived at the end of five days.

When a solution of sesquioxide of chromium in concentrated sulphuric acid is boiled with a small quantity of chlorate of potash, chromic acid is formed. With very dilute sulphuric acid this does not at once occur, but after boiling for some time the acid becomes more concentrated, and a portion of the chromium is then oxidised. Nitrate of potash produces no similar result when used instead of the chlorate in this experiment.

When dissolved in concentrated nitric acid, sesquioxide of chromium is slowly oxidised by peroxide of lead in the cold, abundant indications of it having been obtained at the end of eighteen hours. The reaction occurs at once if the acid be boiled. Minium also, when boiled with solution of sesquioxide of chromium in concentrated nitric acid, rapidly converts it into chromic acid. With peroxide of manganese no chromic acid was obtained, either by boiling, or after standing in the cold during a week. When a solution of sesquioxide of chromium in concentrated nitric acid is boiled with a small quantity of chlorate of potash, the chromium is rapidly and completely converted into chromic acid. With very dilute nitric acid this does not occur. Nitrate of potash having been substituted for the chlorate in this experiment, no chromic acid was formed.

With concentrated chlorhydric acid and the above-mentioned oxidising agents, only negative results were obtained. As a general rule, it is not easy to oxidise sesquioxide of chromium in the presence of free chlorhydric acid, a fact which accords with the well-known reducing action exerted by this acid upon solutions of chromic acid or of its salts.[1]

When dissolved, or merely suspended in dilute aqueous solutions of the fixed alkalies, sesquioxide of chromium is readily converted, even in the cold, into chromic acid, by the action of the peroxide of lead and of manganese, by permanganate of potash, and with peculiar rapidity and completeness by bromine. The application of heat favours the reaction in each of these instances. Iodine, also, at least when the mixture is heated, appears to behave like bromine; the oxidation is, however, much less rapid. Chromic acid is also formed when red oxide of mercury or hypochlorite of lime is heated with a mixture of sesquioxide of chromium and solution of caustic alkali; none was obtained by the action of stannic or of arsenic acid, nor can minium be used in place of peroxide of lead, since it does not appear to exert any oxidising action upon sesquioxide of chromium when in presence of the alkalies.

When mixed with ammonia, oxide of chromium is readily oxidised by peroxide of lead, peroxide of manganese, or by solution of mineral chameleon the free alkali of which has been neutralised, if heat be applied. A similar oxidation also occurs, though slowly, in the cold. With bromine no chromic acid was obtained, a result not at all surprising, in view of the violent reaction which occurs when this substance is mixed with ammonia.

In studying the reactions which have just been described, I was met at the outset by the difficulty that none of the tests for chromic acid, viz. precipitation of sparingly soluble chromates of the metallic oxides, which are in common use, were sufficiently delicate for the purpose. Indeed, besides the yellow colour of solutions of the chromates, which is of course far from being characteristic, there is no test for traces of this acid which is susceptible of rapid and general application, excepting the formation of perchromic acid by means of peroxide of hydrogen. Having, like Reynoso, been compelled to resort to this reaction, I have found it incomparably more sensitive and characteristic than any of the other tests

[1] *Vide* Rose, *Handb. der analyt. Chem.* i. 355 (Braunschweig, 1851).

for chromic acid. Taken in connection with the yellow colour of solutions containing chromates, it affords a test of remarkable delicacy. It depends, in brief, upon the fact, that when a solution containing chromic acid is poured into a *dilute*[2] solution of peroxide of hydrogen, perchromic acid is formed; this imparts a beautiful, though exceedingly evanescent, blue colour to the solution. The perchromic acid is soluble in ether, which removes it from its solution in water without injuring its colour, which, indeed, disappears far less rapidly from the ethereal than from the aqueous solution.

The details of the process to be followed in applying this test may be found in Barreswil's *Memoir upon Perchromic Acid.*[3]

I have obtained satisfactory results by operating as follows:—A solution of impure peroxide of hydrogen is prepared by triturating peroxide of barium with water in a porcelain mortar, and pouring the thin paste obtained, by small portions, into a quantity of common chlorhydric acid, which has previously been diluted with four or five parts of water, the latter being agitated meanwhile with a glass rod. The solution thus obtained may be kept for a considerable time without undergoing change. I have not, for that matter, noticed any decomposition in those with which I have operated.

A piece of peroxide of barium, as large as a pea, is more than sufficient to prepare 150 cubic centimetres of the solution. In testing, some six or eight cubic centimetres of the solution of peroxide of hydrogen are to be placed in a narrow test tube and covered with a layer of ether about half a centimetre in thickness. The solution suspected to contain chromic acid is now to be poured little by little into the solution of peroxide of hydrogen, the tube which contains the latter being closed with the thumb, and gently inverted after each addition, so that the ether may dissolve the perchromic acid as fast as it forms. All violent agitation of the mixture is to be avoided, since it tends to hasten the destruction of the blue colour. The result of the test can hardly be deemed satisfactory unless a blue ethereal solution is obtained, for many of the salts of chromium impart a bluish-purple colour to their aqueous solutions. Since this colour is persistent, however, it cannot be confounded in any case with the fugitive blue of perchromic acid, although it might at times conceal the latter so long as it remained dissolved in the water; for the rest, it is absolutely insoluble in ether.

One or two experiments regarding the delicacy of the reaction may be mentioned in this connection. A solution containing one part of normal chromate of potash in 20,000 parts of water afforded a perfectly distinct blue ethereal solution of perchromic acid, when tested with peroxide of hydrogen, as above described. A solution of one part chromate of potash in 30,000 parts of water also gave a distinct reaction, though the blue colour was less deep than in the preceding experiment. With 40,000 parts of water the reaction was faint, though still discernible, as much so, perhaps, as the yellow of the aqueous solution of the chromate.

I have also detected, by means of this test, the presence of chromic acid in the aqueous solution of a bead of ordinary size, obtained by fusing sesquioxide of chromium with borax in a loop of platinum wire in the oxidising flame of the blowpipe. Plattner[4] had already supposed that the yellowish colour which compounds of chromium impart to borax in the oxidising flame, was due to formation of chromic acid. It is doubtful, however, whether the fact has been previously experimentally proved.

(*To be continued.*)

[2] It is of the first importance that the solutions used should be dilute, since no perchromic acid is formed in concentrated solutions; or if formed, it is decomposed again instantly.

[3] *Ann. Ch. et Phys.* (3) xx. 364.

[4] *Probirkunst mit dem Loethrohr*, von *Plattner* (Leipzig, 1853), s. 144.

Note on the Conversion of Cadmium into Oxide, by a Mixture of Nitric and Hydrochloric Acids, by Thos. Salter, *F.C.S.*

On the 10th of January I added to 218·75 grains (½ oz. avoirdupois) of finely granulated metallic cadmium, first, 1 fluid ounce of water, then ⅜ths fluid ounce of pure strong hydrochloric acid, and then ¼ fluid ounce of pure strong nitric acid, with a view to immediate use. Other matters, however, claiming my attention, the uncovered test glass was put aside and forgotten until the 21st of April, upwards of three months.

On returning to the mixture, I found that a dense pasty precipitate had formed, occupying nearly the whole bulk, and scarcely more than kept moist by a small quantity of liquid. This, separated by filtration, was strongly alkaline to test paper, and evolved ammonia when heated with caustic potash. The precipitate, which was mixed with a few particles of undecomposed metal, after washing and drying, amounted to 220·75 grains. Carefully dissolving the former in very dilute sulphuric acid (which caused a slight effervescence, showing that some carbonic acid had been absorbed), the metal was collected upon a filter, and found to weigh 6 grains, which, being deducted from the above, give 214·75 grains as the weight of the hydrated and partly carbonated oxide. The solution of this, thrown down by carbonate of soda, washed, dried, powdered and ignited, yielded 167·375 grains of anhydrous oxide or CdO.

Thus, of the 218·75 grains of cadmium present, 146·453 grains (=167·375 of CdO) consisted of the dense pasty precipitate before mentioned, 6 grains remained in the metallic state, and 66·297 grains were held in solution; that is, nearly two thirds had been, through the production of ammonia, converted into hydrated oxide.

From subsequent experiments I found that the same mixture fresh made, and kept at a gentle ebullition for a quarter of an hour, became opaque, contained a considerable quantity of precipitate, and strongly blued red litmus paper dipped into the liquid; and that not heated, but allowed to stand an hour, the mixture on stirring became semi-opaque, and contained a moderate quantity of precipitate, and slightly blued red litmus paper dipped into the liquid. No blue tinge was imparted to the paper in either case when held over the mixture.

TECHNICAL CHEMISTRY.

On the Practicability and Probable Efficacy of the Proposed Plan for Deodorising the Sewage of London by means of Perchloride of Iron, by H. Letheby, *M.B.* &c.[1]

Dr. Letheby adds another protest against relying on the use of the perchloride. He says:—"The plan which is recommended is to cast into the sewers during the hot weather a concentrated solution of perchloride of iron. This is to be used in the proportion of about six grains to the gallon of sewage; and the precipitate which it forms with the sewage is not to be removed, but is to be allowed to flow into the Thames with the rest of the liquor. The

[1] From a Report to the Commissioners of Sewers of the City of London.

result of this will be, not a *prevention* of the putrefactive process, but merely a *delaying* of it. At the utmost its effects will last for only about nine days, and then the putrefactive change will continue in its usual way. This is not only the result of my own experience of the process, but it is also admitted to be the experience of Drs. Hofmann and Frankland, who have advised the board on the subject; for they say 'that the suspended matter, even when separated from the deodorised sewage, rapidly passes, in warm weather, into a state of active putrefaction.' The same opinion has been again and again expressed by Dr. Hofmann in respect of the solid matter which is cast down from sewage by the addition of lime. He has even gone so far as to say, that on sanitary grounds no process of disinfection is perfect that does not *destroy* the organic matter of sewage, as is the case with chloride of lime, and the permanganates of potash and soda.

"When chloride of iron is added to sewage, the utmost effect of it will be but to fix a small portion—about one-third—of the ammonia contained in sewage, and to precipitate the sulphuretted hydrogen as a black and filthy-looking compound. This precipitate will be rapidly cast down, and will carry with it the suspended matters of sewage, leaving a clear liquor in which the organic miasms are untouched; and here it is that chemistry, when unassisted by pathology, physiology, and hygiene, is liable to the most serious errors, and may give rise to a dangerous confidence in her abstract speculations. Doubtless the removal of a filthy odour like that of sulphuretted hydrogen may in some degree be an advantage; but there is not the remotest proof that these are the only or even the principal agents which excite disease, and there is no scientific reason whatever for believing that their removal is sufficient to interfere with the origin or spread of epidemic disease.

"But worse yet:—Not only is the clear liquor still charge with ammonia and organic miasms, and so far is not disinfected, but the bulky precipitate, which contains all the suspended organic matter will soon subside, because of its high specific gravity, and will settle upon the banks of the river, where it will be left by the receding tide, and where its disgusting appearance will assuredly excite alarm; besides which the putrefactive changes through which it will pass, will render it no less offensive than the present mud, which Dr. Hofmann has characterised as 'by far the most serious evil which results from the discharge of the London sewage into the river.'

"If the process recommended to the Board had for its object the *separation* of suspended matters from the sewage, and the disposal of the clear defecated liquor, it might perhaps have been applied with some prospect of of success; for I am fully convinced that no process of disinfection will be successful that does not provide for the *final and complete removal* of the suspended matters of sewage. The mere addition of a precipitant, without the separation of the feculent matter so precipitated, is abundantly proved by experiment and observation to be a wasteful and worthless proceeding.

"Even in the case of the iron solution, which is proposed to the Board, it has in every instance most signally failed as a practical deodoriser. More than two years ago I made a large number of experiments on the deodorising power of perchloride of iron, and I found that it was the least effective, and at that time the most expensive of all the deodorisers known. I calculated that if it were used in proper proportion, to check finally and completely the putrefaction of sewage, it would cost nearly 8,000,000*l.* a year to deodorise the sewage of London Since that time the price of the solution has fallen to a twelfth part of what it then was; but its cost as an effective deodoriser is still enormous. It is not ten or twenty or forty grains of the solution that will have a proper hygienic effect upon the river; but it must be used in the proportion of hundreds of grains to the gallon to put a final check upon the putrefactive process. This I have demonstrated by actual experiment, and therefore speak of it with confidence.

"I refrain from entering more deeply into the subject; for the reference to me merely requires that I should express my opinion of the proposed scheme. It is therefore sufficient for me to say that as far as my knowledge and experience and experiments have gone, I am led to the conclusion that the use of perchloride of iron, as a disinfectant of sewage and a purifier of the Thames, will be a serious failure, unless indeed means are taken for the separation of the solid matter from the sewage and the disposal of the clear liquid alone.[1]

New Process for the Manufacture of the Sulphates of Potash and Soda, by M. Marguerite.[2]

When sea salt is calcined with a sulphate the base of which will form a volatile chloride, the chloride can be secured by distillation and the sulphate of soda remains as the fixed residue. In this way a mixture of sulphate of zinc and chloride of sodium when calcined gives rise to the formation of chloride of zinc which distils, and sulphate of soda which is left behind. Many other sulphates give the same reaction. Hitherto these results have not received any industrial application, for the following reason: the manufacture of sulphate of soda in this way necessarily implies the low price and a large quantity of the sulphate which will be employed for calcination, and salts of this class are either manufactured products or residues of too high a price to allow of their being used for this purpose. Sulphuric acid, however, exists ready formed in nature in inexhaustible quantities, as in the sulphates of lime and magnesia in sea water, and in gypsum, &c. If then we can by means of these different sources of sulphuric acid quickly and cheaply prepare a sulphate, and also form a volatile chloride which can be easily reconverted into the sulphate and so used over and over again in subsequent operations, the problem is resolved. Now we shall see by the reactions which follow that the sulphate and chloride of lead exactly answer these requirements.

If we wish to obtain the sulphate of soda or potash, we calcine at a red heat a mixture of equivalent proportions of sea salt or chloride of potassium and sulphate of lead. The mass easily fuses and becomes limpid and transparent. From the surface there rise thick vapours of chloride of lead, which are no longer produced when the reaction between the chloride of sodium and sulphate of lead is ended, that is to say, when the sea salt is changed into sulphate of soda, and the sulphate of lead into the volatile chloride of lead. At this stage of the operation the fused mass is run off and treated with water to dissolve the sulphate of soda which is purified by crystallisation. An insoluble residue of sulphate of lead is left, the amount of which depends on the length of time the mixture was calcined. This sulphate of lead which has not been acted on is

[1] In deference to the reports of Drs. Odling and Letheby we suppose, the Metropolitan Board has advertised for a daily supply during the summer months of upwards of fourteen tons of chloride of lime.—Ed.

[2] *Comptes-Rendus*, t. l. p. 760.

employed in a subsequent operation, — the chloride of lead which has been condensed is suspended in water charged with sulphate of lime, or in sea water which contains the sulphates of lime, magnesia, potash, and soda. In every case the chloride of lead is changed into sulphate, soluble chlorides being formed which can be washed out. In this way, after every calcination, the sulphate of lead can be regenerated for the next operation.

The reaction is expressed by the following formulæ:

$$NaCl + PbOSO_3 = NaOSO_3 + PbCl$$
$$PbCl + MOSO_3 = PbOSO_3 + MCl.$$

MO represents the base of any soluble sulphate, for to reconvert the chloride of lead into sulphate we may use the sulphates of iron and alumina obtained by the oxidation of aluminous schists, or indeed any soluble sulphate whatever.

When the chloride of lead is digested with the sulphates of lime, magnesia, iron, or alumina, all the lead is recovered as sulphate, except a small quantity, which is eliminated in the washing; the amount, however, is so small, that the water is only coloured slightly brown on the addition of hydrosulphuret of ammonia. It is, nevertheless, very important to operate with dilute solutions, for if sulphate of lead be placed in contact with strong solutions of the chlorides of potassium, sodium, magnesium, or calcium, it is changed into chloride of lead, which is not the case when dilute solutions are used.

The possibility of regenerating the sulphate of lead was the most important fact to establish, for the economy of the process is based on the success of that operation. In constructing an apparatus for carrying on the process, two things must be particularly borne in mind—1. The floor of the furnace in which the calcination is made must be extensive, and but slightly hollowed, so that a large surface of small depth may be exposed, in order to facilitate the volatilization of the chloride of lead. 2. The arch of the furnace must be elliptical, so that a current of air or steam may rapidly carry off the vapours of the chloride from the surface.

To recapitulate, the operation I propose for the preparation of the sulphates of soda and potash consists in a simple calcination of sulphate of lead with the chloride of potassium or sodium, and in the reproduction of sulphate of lead by the contact of the chloride of lead first produced with sulphate of lime, or any other soluble sulphate.

This continuous process for preparing the sulphates, without free sulphuric acid, the author observes, appears to offer many advantages over the old process.

PHARMACY, TOXICOLOGY, &c.

Solubility of Alkaloids in Chloroform and Olive Oil.

	100 parts of Chloroform dissolve	100 parts of Olive Oil.
Morphia	0·57	0·00
Narcotina	31·17	1·25
Cinchonia	4·31	1·00
Quinia	57·47	4·20
Strychnia	20·09	1·00
Brucia	56·70	1·78
Atropia	51·19	2·62
Veratria	58·49	1·78

The above determinations have been made by Pettenkoffer. The employment of these solutions has been suggested for the external application of the above remedies.—*Journal de Pharmacie.*

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Product Collection in the Museum, by Ed. Lankester, *M.D. F.R.S.*

Lecture III. (April 24, 1860.) *On Leather.*

In pursuance of the course which I have commenced, I shall to night draw your attention to the skins of animals. In my last lecture I drew your attention to wool and its various applications in the arts. I alluded to the fact that wool was only one of those epidermal appendages, as they are called, of animals. I now pass over the use of horse hair, of human hair, of feathers, spines, hooves, and horns, all of which are epidermal appendages, because I shall come to them again by and by, and treat of them in a separate lecture. We will now talk of the skin or substance out of which those epidermal appendages grow. I drew your attention to the epidermis in the last lecture, and stated that the skin was composed of these two parts, the epidermis and the dermis. The epidermis is a membrane composed of cells on the external surface of the dermis or true skin. This epidermis is continued in the animal into the mouth, and into the organs of respiration, but when we get into the interior organs we call it, instead of a skin, the mucous membrane, and we find this mucous membrane is covered with scales. This mucous membrane is called the epithelium, and the scales are called epithelial scales. I only want to show you that the skin is continuous with the mucous membrane, and you may regard an animal as a sort of bag; when the internal organs are to be made the skin is, as it were, tucked in. But we have nothing to do to night with the internal organs or membranes, which are however used in the arts. I have only to call your attention to the skin itself. Now there is one point with regard to the epidermis which I want to allude to before I leave it. The epidermis gives the colour to the animal, not only to the lower animals, but also to man. Sprinkled among the cells I have spoken of, you will find a quantity of polygonal cells called pigment cells, which give the colour. When those pigment cells are absent, we call the persons albinos, of which we are descendants; and when those cells are abundant we call the persons blacks, and in proportion to the number of these cells is the colour of the individual or the races of mankind. These cells are in that portion of the epidermis which forms the hair, and when the epidermis produces black cells, those black cells are formed in the hair as well as upon other parts of the skin, and thus we have black hair and white hair arising from the pigment in these cells. So with the lower animals; the black animals have these pigment cells, whilst the white animals are without them. Again, these cells are so constructed as to reflect a variety of colours, and so we have red animals, and the various kinds of brown produced by those pigment cells.

Now, passing from the epidermis, I come to the layer which lies below it. You see the importance of understanding thoroughly the structure of the skin to those who have to convert it into leather, and it is to the want of attention to the structure of the skin that a good deal of the backwardness of tanning in former years was due. Lately there has been an improvement in the process. I now call your attention to this under layer, which is the dermis. Now this is composed of a basement membrane, in which there are blood vessels. The cells, which are above, are produced by the agency of the blood vessels. We have arteries in one direction, and veins running out in the other, so that this thick part of the skin is supplied with blood vessels. That those blood vessels are present, we can see in the leather after it is tanned by the fibrinous condition of the leather.

Then we have in this skin, which is the organ of touch, a variety of nerves running from the spinal cord. These nerves run up into the papillæ of the skin, and give the power of receiving the impression from outward objects. The skin is then the organ of touch. Now, in addition to

this, we have in the skin a number of glandular apertures, a series of little glands which are called sebaceous glands, or sebaceous follicles. Those little glands are intended to secrete a quantity of matter which is constantly accumulating upon the skin, and which keeps the skin elastic; and it is those little glands which frequently get blocked up and form little black pimples on the face; and sometimes in these follicles you get an insect, the *acarus folliculorum*, and those are most often found in the side of the nose. But it is to the perspiratory glands to which I call your attention more particularly. They consist of a little tube which runs through a gland, which is well supplied with blood vessels, down to the thicker part of the skin. Now the great function of these glands is to draw nourishment from the blood, and they open by little pores into the skin, and if you look at any portion of the skin, the top of the thumb, for instance, with a common magnifying glass, you will see that there are a series of lines and little pores, which pores are the terminations of these perspiratory ducts. Curious calculations have been made as to the number of these pores; thus Wilson states that there are 3528 in a single inch of the skin, so that in an ordinary sized body there are not less than 2,300,000 of these pores, and these tubes have a certain length, and it is calculated that there are not less than twenty-eight miles of this tubing. Now the great function of these glands is to keep the heat down. If it were not for that, we should get up to a higher temperature than 198. You can easily understand how these glands act by placing a cloth over a tea kettle, and wetting the cloth with cold water so as to keep the kettle at a given heat. In the same way the perspiration assists in keeping down the temperature of the body, and that is the function of this great mass of perspiratory glands. Thus you see that the skin is a very complicated organ. Now the chemical substance of which it is composed is principally that gelatine of which I have spoken before. This gelatine can easily be procured from all parts of the animals. We obtain it from the refuse of various manufacturing processes, the clippings of hides, the refuse of bones, and the tips of horns. Now the fact of its being present in the skin constitutes the foundation of the art which I am about to bring before you this evening. There could be no tanning if it was not for the presence of this gelatine. Now this gelatine has the properties which I mentioned in the first lecture, of being insoluble in cold water but soluble in hot water, so that we may take skins and put them into cold water for any time and they will not dissolve, but we can take these clippings of skins and dissolve them by heat, and when we evaporate the water we leave the gelatine behind. Now this gelatine is used for making size and glue, and it is also used for diet. We take sometimes even a coarse kind of leather, and boil it down and make it into gelatine, and then into jellies. This gelatine exists also in the sturgeon, and some other kinds of fish, under the form of isinglass. Now one remarkable property of gelatine is, that when it comes in contact with a substance which we know by the name of tannic acid it forms an insoluble precipitate. And here is a very remarkable thing, to be thought of for a moment, that two soluble substances, meeting together shall form an insoluble substance. If you add a little solution of tannic acid to a solution of this gelatine you will have a substance precipitated which we call tanno-gelatine, which is exactly the substance formed by immersing a piece of skin in tannic acid. It is due then to this great fact of the presence of gelatine, that the whole of the manufacture of leather by means of tannic acid depends. But before I speak more particularly of tannic acid, I would just say this, that although when we boil skins and other parts we get this substance which we call gelatine, and which we separate, yet there is no proof that this substance is contained in the skin or in the animal substance before it is boiled. Therefore it is wrong to say that leather is merely tannic acid and gelatine, because we do not boil the skin and convert it into gelatine when we make leather. I wanted to say that to correct a general impression which might be conveyed when one talks of these tissues being composed of gelatine. Then of what are the tissues composed? Why they are composed of a gelatiginous substance which, if you put it into water, forms gelatine. I think I shall show you that we do not know everything about leather making to night, and it is not to be taken as a settled question that gelatine is the substance which we convert into leather in the way that the tannic acid and the gelatine mixed together produce an insoluble substance.

Now what is tannic acid? Tannic acid is a substance that Sir Humphry Davy discovered to be present in all barks and vegetable matters which have been employed by the tanner in converting skins into leather. He called it tannin; but as it is found not to be a neutral substance, but capable of combining with metals to form a class of salts called tannates, we call it tannic acid.

There is another acid which is constantly formed with the tannic acid, and this is gallic acid. Gallic acid is called gallic acid from the galls in which it is found in largest quantities. Why I mention more particularly this gallic acid is that gallic acid will not tan, will not form an insoluble precipitate with gelatine, will not combine with the hide at all; but under certain conditions tannic acid will rapidly change into gallic acid. By free exposure of tannic acid to the air the change takes place, and by taking the old tannic material after it has been used, you find that this old substance will actually start the change of tannic acid into gallic acid, and thus there are several processes and several circumstances under which the tannic acid, which is so useful to the leather maker, really becomes converted into gallic acid, which appears to be of little or no use at all. The only use suggested in the process of tanning is that it may soften the skin. Sometimes the skin is put into sulphuric acid to soften it. Now it has been suggested that the gallic acid may act as the sulphuric acid does, by opening as it were the pores of the skin and allowing the tannic acid to get in. But that leather which is formed by means of tanning substances which will not form gallic acid is not liked by the shoemaker, is not liked by those who buy leather directly from the tanner. Those who are familiar with leather know that there is on the outside what they call "bloom," which is peculiar to the surface of the leather, just as the bloom upon the peach, the plum, and upon a variety of flowers. Now it would appear that unless a certain quantity of tannic acid is converted into gallic acid you get no bloom, and therefore the buyer is obliged to use a certain portion of gallic acid in order to supply his customers with this matter of taste in the bloom.

Now having said this much of the tannic acid and the gallic acid, I will speak of the sources of tannic acid. I would just first say that both form with iron black salts, and consequently form an exceedingly valuable means of producing dyes. Thus, for instance, leather itself may be made to turn black upon the application of iron. Cloth and other materials are dyed black, and if I had time I might speak largely of the tannates and gallates of iron. All I will say, however, is that we use these nutgalls for the purpose of producing our common black ink, which is formed from the gallic acid contained in the nutgalls and the iron. So you see how these two acids are related one to the other, and how they both have almost the same relation to these salts of iron.

Now the plants which yield tannic acid are very numerous, and as chemistry has made inquiry into the nature of materials employed in the arts, we have found that the substances which contribute tannic acid have become more numerous. The tanner of old used oak bark. The old English oak bark was the source of the tannic acid which has been employed from time immemorial, and to the present day it is the oak-tree which yields us the largest quantity of bark. The consumption of bark in this country is 50,000 tons per year, and there is not more than 5000 imported from other countries. It is always a difficult thing for me to recollect figures, and I am not quite certain those I have

given are perfectly correct; however, the quantity is very large, and it is the principal substance which is employed for the production of the leather in this country. The bark is cut in the spring of the year. Young trees twelve years old are those which are preferred by the tanner. It is said, in fact, the older a tree becomes after twelve years the less tannic acid the bark will yield, so that you may perceive about twelve years old is the best time. Then, again, it is important that the tree should be barked in the spring. It is stated that in mild springs the tannic acid is found in larger proportion than in wet and cold springs. I should think the tannic acid will be exceedingly small this spring, and probably very few tanners who know these facts will think of speculating in oak bark at all. However, it is stated that the yield of the tannic acid is very much larger if the bark is obtained during the time that the sap is ascending. Sometimes the tree is cut down, and I think it is the most *humane* way, for of all the eye sights which are presented to our minds there is scarcely anything so offensive as the ghost of the stripped oak-tree standing bleached and bare. This great giant of the forest, thus exposed to the rude blast, soon dies, for of course they do not grow after the barking. I said just now that we consume 50,000 or 80,000 tons of oak bark per annum, and now, after referring to some memoranda, I find it is between 200,000 and 300,000 tons, so that I was wrong to trust to my memory, and not more than 4000 or 5000 tons are imported. There are other substances which are also used in tanning, but I will speak of those which are the least known. I have here two sorts of acorn cups; the one called Velonia is the produce of the oak of the Levant. These acorn cups contain a very considerable quantity of tannic acid, and are more effective by weight than the oak bark. Sir Humphry Davy calculated that four pounds of oak bark ought to make one pound of leather. Now I think it is a very much larger quantity from Velonia than from oak bark. I find I have got a note to the effect that two pounds of Velonia will produce one pound of leather, and this is a very good way of expressing the tannic qualities of a substance.

Now there is another substance which is used in making finer leathers, and this is the produce of a plant sometimes found in this country, but always found abundantly in the south of Europe, and is known by the name of Sumach, of which there are two kinds, one the *Rhus coriara* for tanning, and the other the *Rhus cotinus* for dyeing. The sumach generally contains from 16 to 20 per cent. of tannin, so that sumach is a better tanning substance than oak bark. It is, however, more expensive, and there are certain drawbacks to its use, as well as to the use of very numerous tanning materials which have to be brought from a distance. Now there are some seeds, of a leguminous plant like peas and beans, known in the market by the name *Divi Divi*. Those are not so much employed as they contain large quantitie of gallic acid. Then there are some things like elongated plums, called by a very long word *myrobolans*. They contain a good deal of gallic acid as well as tannic acid, and can be employed by the dyer as well as the tanner, but still have the drawback of colour in leather. Then I have the substance called catechu, or cutch, or terra japonica, because it was supposed to be earth. It was used as a valuable medicine as long as 200 years ago, but subsequently it has been found to contain 50 per cent. of tannin. The natives cut down the trees which yield it, and ladies are principally employed in this occupation. They cut the trees up into logs and boil them in water, evaporate and expose the decoction to the action of the sun to finish the evaporation, and so obtain an extract which contains 50 per cent. of tannic acid. Large quantities are brought to this country from various parts of the world besides the East Indies. Mungo Park introduced dragon's blood, which is an exudation from the *pterocarpus draco* and other species, and which contains 70 per cent. of tannic acid. It is also called kino, and kino comes into the market to compete with oak. These are found to be very admirable substitutes for the oak bark and the other substances. Besides these there are a great number of other substances. Here is a tanning bark brought from the Cape colonies known as the hemlock spruce. It belongs to the pine tribe of trees, and is an excellent substitute for our oak bark, but I fancy it colours the leather. The *pinus larix* grows abundantly in Scotland, and is used extensively in tanning, but the leather is a second rate leather. I may here remark it is always worth the while of a manufacturer to make a second rate article provided he does not ask a first rate price. Now willow bark, ash bark, and so on, have been employed for converting hides into leather. Then there is a bark from Australia, the mimosa or wattle bark, which is useful. These are very important facts for people to know in this country. We, you know, are none of us going to live the whole of our lives in England. We all contemplate one day emigrating if the Reform Bill or the Food Bill, is not passed, or something else, and therefore we are always travelling, or going to travel, and it is of the very greatest consequence that we should take with us a knowledge of the arts and sciences and the great principles of our manufactures to our colonies. If we had done so at first we should have earlier found gold in Australia. We should have obtained wool earlier from Australia, and we should have found more tannin if the colonists had been better educated in the arts, sciences, and manufactures. Therefore I say let us educate our boys now so that when they go out and see a thing likely to be useful they will not pass by it as if they possessed no more sense or intelligence than the wild animals of the region, and thus by the diffusion of a knowledge of these facts even in our colonies we shall contribute as much to the wealth of the mother country as possible. Many plants also contain tannin that we should not think of using for the purpose of tanning leather, thus we have the tea plant. A quarter of all the tea we use is tannic acid, that is to say, every pound of tea contains a quarter of a pound of tannic acid. There is no fear of its turning the mucous membrane into leather, for during life the stomach does not submit to the process of tanning, although tea is sometimes a great offender of the stomach by reason of its tannic acid. I may mention that there are persons in India who chew catechu and also the betel nut, which is a product of the lime-tree, and which also contains tannin. This is cut up and mixed with a little lime and long pepper, and is used throughout India, and not only by Indians but by Europeans who have acquired the habit and who slyly practise the barbarous habit of chewing it when they get back to England. Then there are a hundred of medicines in the Materia Medica of the Pharmacopœia, all of which depend upon their tannic acid for their medicinal properties. The old physicians had their long lists of substances which, when they come to be examined, are found to depend for their medical properties upon their tannic acid. Now I want to show you what is submitted to the process of tanning. There is no skin that is not composed in the way I have mentioned, having more or less the characteristics of the human skin. The human skin may be tanned, but it resists tanning to the last, and requires much longer treatment than the other skins. I do not know whether that accounts for the fact that men will bear a great deal more punishment in knocking about than other animals, and perhaps that fact may account for the sympathy of the last few days with men who met together to what is called tan each other. The hides of whales, hippopotamuses, and other creatures, have been submitted to the process of tanning, but these do not come into the regular business of the tanner. The most important are horses hides from America. You know that throughout the pampas of America there are men constantly employed in horse hunting, who supply us with tallow, skins, and bones, no part being lost. Those skins come to us preserved in salt. Not only horses hides but all other kind of hides, ox hides, and sheep skins, and so on, can be imported in this way. Then we have cow hides, which are principally employed for the soles of shoes. Calf skin is used for making softer leather, which is

used for the upper parts of shoes. Sheep skins are used for making what are called chamois and morocco leathers. Lamb skins are used principally for making gloves. Then we have deer skin used for the finer kinds of what we call morocco, which is used for book-binding and ornamental purposes. Then the goat skin is used in various parts of the world for making bottles. We shall see by and by that those who deal in leather may truly say *there is nothing like leather*, for after all you may use it for more purposes in the arts than you can use any other substance. Seal skins are imported into this country in prodigious quantities; 600,000 seal skins have been imported in a single year for the purpose of making black enamelled leather, used for making boots and shoes of a higher kind or quality. It is also used for bags, dressing cases, and a variety of ornamental things. This enamelled leather is made by the addition of varnish on the blackened surface. Then we have such skins as the hog skin which will not tan very well, because of the large quantity of fat which it contains, which constantly resists the action of tannic acid, but it is employed extensively for making saddles. Then we have the buck or the doe skin for making gloves and gaiters, and the French catch rats very extensively, and make use of them for the purpose of converting their skins into leather, and I have here a quantity of gloves made from the rat skins. If you are anxious to avoid the fact of appearing in a ball room with rat skin gloves you may know them by this, that sometimes in preparing the gloves they leave a hair or two upon the surface of the skin, and by putting the glove under the microscope you can sometimes detect these hairs. So, ladies, if you wish to avoid the disgrace of appearing in a ball room in rat skin gloves, get a microscope and examine every hair you find upon them. Thus you see it is not one kind of skin alone that can be employed, but every kind and form; for there is no one that does not submit to the action of this tannic acid.

Now I would just say with regard to the preparation of the skins, that the processes are more of a mechanical kind than involving any chemical or physical principles that need elucidation. It certainly looks at first sight a remarkable operation by which these pieces of skin should be converted into leather. Now the skins are called by various names. The tanner does not speak of all things as skins, he applies that name technically. Small skins, such as those of dogs, rats, cats and mice, he calls skins, but when the leather comes from the ox it is a hide, from calf it is a skip, and thus he divides them, and it is a practical difference, for he treats them all differently. The first step is to soften the skin, which is done by soaking it in water; and generally this softening process is followed up by a process of liming, which assists in carrying off the hair and the epidermis. I say liming, because it is generally the process in use in this country, but we may use sulphuric acid or acetic acid. When we get rid of the epidermis, directly under the skin is the subcutaneous adipose tissue, which is very much against the action of the tannic acid, and therefore it is necessary to scrape away this fatty matter. After having then subjected the skins to these various processes for the purpose of removing the epidermis, first on the outside and then the fat on the inside, the application of the tannic acid comes in. Now these skins are all put in contact with these barks or substances containing tannic acid, and there are two ways of applying them—wet and dry. If dry, you take a quantity of spent bark, and then you put some fresh bark, and then you put a hide and then some fresh bark, and then a hide, and so on until at last a quantity of water is put in, and the water finishes up the process of tanning.

Then there is a way of putting the hide directly into the tan pit. You get a quantity of water and tannic acid, and you put them directly into that, sometimes for eighteen months or two years, and the longer the process goes on the better for those who buy the leather. This is a long process, and it is only the capitalist who can afford to wait two years for return; hence it becomes of importance to open up this trade, and so various processes have been introduced since 1823 for facilitating this long process of converting hides into leather. I fear I should not interest you much in going over the large number of processes which have been invented. I will only say that many patents have been taken out to hasten the permeation of the tannic acid through the pores of the leather: they applied hydrostatic pressure to facilitate the passage of the tannic acid through the leather, but then it turned out that those leathers did not wear so well, so that the old tanner has got the better of the young tanner with his new process. But the new processes are still going on contending with the old processes, and you may find in Leadenhall Market that leathers are tanned in all sorts of ways. One of the last processes I will just mention, which is one that is employed by Syne of Warrington. Large wooden cylinders are erected, and into these wooden cylinders the hides are introduced, and then a quantity of water and tannic acid is introduced hot, and then those cylinders are turned round rapidly so that the hides are beaten about in the midst of a quantity of warm infusion of tannic acid. Now here you have three things necessary. In the first place there is no doubt that warmth, when it does not reduce the quality of the leather, is a thing which facilitates the introduction of the tannic acid into the gelatine. It is possible that the warmth may convert a particular substance into gelatine, and that the tanno-gelatine may not be so endurable as the leather made cold: but there is no doubt of the question of facilitating the process. Then, again, there is the constant agitation, which no doubt must affect a great quantity of union which the ginet lying in the tan pit will not effect, and which is certainly a clear gain. Then I told you just now of the tannic acid being converted into gallic acid by exposure to the atmospheric air. Here you get rid of that objection. But I do not know whether that is a good speculation, or whether the leather is as good as that obtained by the old process. Some of the other processes of passing the hides through the hydrostatic pressure have answered very well.

Now some of the leathers are curried, which is a process of a cleaning, rasping, and grinding away with pumice stone, and various other processes, and especially what is called dubbing, that is rubbing in oil, which makes it more elastic for the upper parts of our boots and shoes. We never, however, curry those parts which are used for soles of boots or shoes. A pair of boots which are made without the aid of the currier have great strength, but you see their inconvenience. Then there are the various processes afterwards carried on, such as the dyeing, enamelling, and so on, and I can only say that those processes are not very complicated. Now I have here a series of illustrations of Mr. Preller's process of making leather, carried on very successfully in Bermondsey, which is independent of the use of tannic acid. There are two substances which will effect this change in leather. One is alum. Alum is formed of sulphuric acid, potash, and alumina. We first immerse the skin in salt. Now by the introduction of the skin into the alum, with the salt we produce an insoluble substance, and the consequence is that you get the leather softer and more durable than the tanned leather.

Then just in the same way we also can make our oil leathers, which we know principally by the name of chamois leather. It is not the chamois skin, for we find sheep and deer and other skins used for this purpose. This leather is prepared much in the same way to begin with as for tanning, by taking off the hair and fat, and then we oil instead of tan. The oil seems to assume the solid condition in the skin, and resists the action of the ordinary agents. Now Mr. Preller, by his process, prepares his skin first by the introduction of starch, gluten, albumen, and things of that kind and afterwards polishes them by the oil process. Then the skin is fulled by means of machines such as are used for fulling cloth. Sometimes they are put into large tubs and rubbed by hand. Sometimes in Bermondsey they are put into large tubs and

men jump in naked and knock them about with their feet. Sometimes they are prepared with the hair on; two are sewed together in this way so that the hair of each is in contact with the other, and we call these leather although they have never been tanned. I have a note here with regard to Russian leather and its delicious smell. The leather is at first tanned in the usual way, and then prepared with willow bark, and then put into a solution of red sandal wood, and then, while the process of currying is going on, the oil from the birch is said to be introduced, but I believe this oil of birch is first scented by the sandal wood.

I have scarcely any time left to say anything about the application of leather. You recollect those bottles of which I have spoken. These ought to be strong, elastic, and of great durability. Here I have a remarkable application of leather, for which everything else has been tried and failed, and that is the making of mill bands. And then you must walk into the harness maker's shop and see the rings and saddles and collars, and so on, of leather. Then you can go into the cabinet maker's shop, and find him covering your chairs and sofas with leather; you go to the railway carriage, and find the seats covered with leather. Then you see this beautiful ornamental work; this is made of leather, stamped and pressed into a variety of forms to imitate any kind of carving, and some beautiful specimens of this kind have been obtained from Mr. Leake of Golden Square. Then we split the skins up into vellum and parchment. On parchment we inscribe our deeds, and on vellum all our great state documents, and here are actually writings dated 1237, 1325, 1428, and 1521, showing that these skins of animals contain the most precious records of the history of our race.

I had intended to have said something with regard to the imitation of leather. Here we have a substance formed out of a piece of paper—this was originally a sheet of blotting paper, and it has been dipped into oil of vitriol and water. It is not regular parchment, but it is a substance which serves all the purposes of parchment.

I ought also to have said something with regard to another beautiful application of leather. We can hardly produce anything which will surpass in beauty of delineation and form this group of birds, and so with this other group upon the table; and thus you may say with those of old who made leather, considering the vast number of purposes to which it is applied that there is really nothing like leather.

SOCIETY OF ARTS, *Wednesday, 2 May* 1860.

Sir Cusack P. Roney *in the Chair.*

Upon this occasion, the paper read was one *On the Employment of Peat in the Useful Arts*, by Mr. W. E. Newton, who commenced his observations by a dissertation upon the importance of minerals and mineral productions to a country, as being intimately connected with its wealth, industry, and general prosperity. Some statistics relating to coal followed, and at length the special subject of the paper, peat, was introduced in the manner here quoted:—"A true peat bog, or flow moss as it is called in Scotland, is a tract of ground generally almost level, often many miles in circumference, consisting of a light, soft, fibrous substance of several feet deep, so inflammable as to be used as a common fuel. It is easily cut with a spade, and when so cut and exposed to the air it changes in a few minutes from a dusky yellow to a blackish colour. The surface of a peat bog is brown or dark in appearance, and even in the midst of summer is wet and spongy, and is commonly covered with heath, coarse grass, and moss, in detached patches, the intermediate and wetter places bearing no vegetable productions. Most deep pit bogs contain different qualities of peat; the upper part of the bog, or that near the surface, is light coloured, soft, and spongy, and contains the vegetable remains but little altered; deeper, the peat is brown, denser, and more decomposed; the lowest stratum is still more dense, and when removed from the bog and dried the mass of turf assumes the black colour and nearly the density of coal, to which it approximates very much in chemical composition. Now if the peat when taken from the bog be carefully examined, even the densest portions, or those taken from the lowermost parts of the bog, will be found to contain a large quantity of vegetable fibres or roots distributed through the mass.

"The black or brown slimy portion of the peat consists of the decomposed vegetable fibres, while the rooty or fibrous portions of the mass consist of undecomposed vegetable fibres. The specific gravity of the light surface peat is 400, water being 1000, and from this it increases in compactness to nearly the density of coal. For all flaming fires peat is applicable, and in its application to steam boilers it is peculiarly useful, as there is no liability of that burning away of the metal which may arise from local intensity of the heat of coke or coal.

"Mr. Burstall of Bristol has published the results of his use of peat with a high-pressure engine. The steam was of 36 lbs. pressure, and there was consumed 74 lbs. of peat per hour. The quantity of water evaporated from the boiler per hour was on an average 360 lbs. which is nearly five times the weight of the peat used as fuel. The following results as to the comparative effective power of peat and coal have been furnished by Mr. Charles Wye Williams, and are derived from the working of the Lansdowne, one of the steamers of the Inland Navigation Company which ply upon the Shannon with goods and passengers. Before the use of peat, a week's work, consisting of 49 hours, consumed 24 tons of coal, costing, at 15*s.* per ton, 18*l.*, or 7*s.* 5*d.* per working hour. To do the same work there were consumed per week 315 boxes of peat, which at 7*d.* per box cost 9*l.* 12*s.* 7*d.* or 3*s.* 11*d.* per hour, a little more than half the cost of coal. Mr. Williams, using well dried peat, found that with a large waggon boiler there were 3·87 lbs. of water evaporated per pound of peat, and that it cost 3*s.* 7*d.* to evaporate 100 cubic feet of water. Now this is 5½*d.* per horse power per working day. When peat was burned in the furnace without Mr. Williams's peculiar mode of effecting perfect combustion, the cost per horse power was 6½*d.* From the experiments that were made at that time, it appeared that in Ireland the horse power of steam cost per day in fuel:—

"Using coals, whether British or Irish . .	7¾*d.*
Peat, properly dried	6½*d.*
" on Mr. Williams's system . . .	5½*d.*

We here omit some lengthy and rather desultory passages on the desiccation of peat, from which we can only discover that the substance in question contains about 30 to 35 per cent. of moisture when denominated "dry," and as much as 75 per cent. when fresh cut, so that Mr. Newton naïvely remarked, "to make one ton of dry peat, four tons weight of turf must be dug from the bog!" The draining process of Mr. Rogers of Robertstown, Kildare, was next noticed by the Lecturer, but a quotation from another part of his paper will probably be more interesting to our readers:—

"It appears that in the department of the Landes, France, there are iron-works at Ichoux which consume turf only; the cost there is about 8*s.* per ton. Forty-five cwt. of turf and 23 cwt. of pig-iron give one ton puddled iron. Twenty-six cubic feet of turf and 25 cwt. pig yield 20 cwt. of bar-iron of superior quality.

"M. Müller of Wadenhammer, a manufacturer of leading notoriety, has proved, by actual working test, that an equal quantity of turf charcoal, used in place of wood charcoal, produces a greater quantity of produce from the ore than the best wood charcoal.

"At Waehter Newnhammer it was found that when equal parts of turf charcoal and wood charcoal were used in place of wood charcoal solely, the quantity of iron was raised from 386 lbs. to 464 lbs., the quality being excellent.

"There are at Ransko, in Bohemia, iron works for smelting, cupolas for re-melting pig, and reverberating furnaces,

&c. for making bar and plate iron. The ore is but middling in quality. The fuel is turf and charcoal only, the turf being of light texture, and not in any way prepared or pressed. The fuel consumed to make one ton of iron is about 34 cwt. of turf and 30 cwt. of charcoal; the cost of the first is less than 9*s.* the latter about 1*l.* 4*s.*; smelting, therefore, costs about 1*l.* 13*s.* and the total cost of pig-iron is about 3*l.* 15*s.* per ton. The quality of the iron is the highest.

"In Bavaria there are iron works similarly worked. One at Königsbrunn carries on the whole operations of fusion, puddling, reheating, and rolling, solely by peat fuel. The commissioners state that the turf is not pressed but carefully dried by means of heat from separate fires or from the furnaces. Berthier states the analysis of this turf to be:—

Volatile matter	70·6
Carbon	24·4
Ashes	5·0
	100·0

30½ cwt. of this turf to 22½ cwt. of pig produces one ton puddled iron.

"30 cwt. of dense turf to 24½ cwt. of puddled iron produces one ton small bars of fine quality.

"The apparent average is that 32 cwt. of properly dried turf to 20½ cwt. pig gives one ton of castings; 30 cwt. turf to 21 cwt. flat iron gives one ton of plates.

"By compressing peat its value as a fuel for metallurgic operations is much increased, and when compressed peat is carbonised it gives a fine coherent coke which contains very little ash. When the coking is properly carried on, the peat yields about 30 per cent. of its weight of coke, and the density of this coke is greater than that of wood charcoal, being found to range from 913 to 1040. The iron furnaces of Voitumra give a still higher per centage of coke when the peat is coked in small vessels.

"The precise figures are:—

"Charcoal	40·25
Tar	24·50
Watery liquor	14·00
Gaseous matter	21·25
	100·00

"The calorie effect of peat charcoal uncompressed is about the same as coal coke, while that of compressed peat charcoal is, as before mentioned, much greater. The value of peat charcoal, whether made from compressed or uncompressed peat, is evident, as is also the increased value of iron made by means of such fuel. I take these to be incontestable facts, and it is almost incredible that so valuable an article as peat should have remained so long almost unnoticed and unemployed by our metal manufacturers. The neglect of peat as a fuel may, and probably has, arisen partly from its bulky nature, and partly from the open or spongy character of a great deal of the peat that is dried in the open air in the natural way, which renders it inapplicable, or at any rate inconvenient, to be used as a fuel for smelting purposes. The compression or solidification of peat by ordinary mechanical pressure is an expensive and slow process when applied to large quantities, and therefore, even although such an operation could be made effectual in expressing the water from the peat, the extensive and costly plant that would be required to work on the scale that would be necessary to meet a moderate demand would act, and no doubt has acted, as a barrier to extensive operations being carried on for this purpose.

"Mr. Holland some time since invented a process of preparing peat so as to render it dense and solid, and more fit for manufacturing purposes than common air-dried peat. By this process the peat, as dug from the bog, was submitted to an apparatus, whereby it was torn to pieces, and when in a finely divided state, it was submitted to a considerable degree of heat, whereby it was not only dried, but the particles were so softened as to cause them to adhere together when pressed. The heated particles were then submitted to heavy hydraulic pressure, whereby they were consolidated, and a firm dense mass, somewhat resembling coal, was produced. In external appearance the product of this process was everything that could be desired, but it was found on trial to be unable to resist an ordinary blast, and the charcoal made from it was of comparatively inferior quality, and not suitable for the manufacture of iron. These defects probably arose from the high degree of heat employed for drying the separated peat, whereby some of the volatile matters were driven off."

Passing over a few columns of unmistakeable "dry matter," we come to the consideration of peat charcoal, which is stated to be a very valuable addition to vegetable and other soils, and calculated to improve the condition of most plants, and also to have been "used with advantage as a remedial agent in indigestion or dyspepsia and its results, viz. flatulence, heartburn, acidity of the stomach, waterbrash, sick headache, impurity of the breath, palpitation of the heart, throbbing of the brain, distension and sense of fulness, giddiness, and the other usual attendants of a disordered stomach." Not content with this, Mr. Newton goes on to recommend the peat charcoal in all diseases of the chest, diphtheria, diarrhœa, cholera, cancer, dysentery, &c.

We refrain from giving any further extracts, not wishing either to weary or amuse our readers too greatly. Of the importance of charcoal as a disinfectant, and occasionally as a remedial agent, we must all be aware, thanks to the researches of Drs. Stenhouse and Forbes Watson, but can hardly be expected to sympathise with Mr. Newton's medical experiments.

The discussion was not of a very interesting character. We will simply mention, on the authority of Mr. P. L. Simmonds, that peat might become available for the manufacture of paper of moderately good quality, and at a very small cost. The process, for this object, of M. Lallemand of Besançon, consisted in washing peat until the earthy matters were got rid of, when the fibrous portion was soaked in a strong caustic lye for twenty-four hours, then in a bath of dilute hydrochloric acid for four hours with agitation, and next, after rinsing, in a weak solution of alum. The bleaching was effected by means of chlorine, and from 5 to 10 per cent. of rag "half-stuff" mixed with the pulp before the final conversion into paper.

The meeting terminated with the usual vote of thanks.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, 3 April 1860.

W. Fairbairn, *Esq. F.R.S. &c. President, in the Chair.*

Dr. F. C. Calvert stated that he had been induced some eighteen months ago, by Mr. J. A. Ransome, to make some researches with the view of ascertaining the nature of the products given off from sloughing wounds, and more especially in the hope of throwing some light on the nature of the contagion known as hospital gangrene. He had, therefore, fitted up some apparatus to condense the various products given off from such wounds, but the quantity obtained was so small, that he deemed it advisable to collect the products given off from a large quantity of meat during putrefaction, and he had found these to be quite of a different nature from what has been hitherto generally supposed. For instance, he found that no sulphuretted nor phosphoretted hydrogen was given off, but, on the contrary, alcaloids containing the sulphur and the phosphorus. He further added that he had great hopes, in time, to be able to discover the nature of the products called miasms. He also stated that he was now engaged in examining the liquids and solids produced during putrefaction, and would at some future time lay the results obtained before the society.

Mr. Henry Bowman exhibited a chart of the temperature of the last winter months, compared with those of previous years. The principal results are tabulated below:—

	Maximum.	Minimum.	Range.	No. of days on which the temperature fell to or below 32°.	Mean.	Mean of 47 years, from 1794 to 1840, inclusive.	Difference between the Mean of 1859-60, and that of 47 years, 1794 to 1840.	No. of months in same period, with Mean as low as 1859-60.
1859.	°	°	°		°	°	°	
October . .	73·0	23·5	49·3	8	49·3	50·0	— 0·7	20
November .	55·3	21·0	34·3	12	40·2	42·9	— 2·7	14
December .	48·8	9·5	39·3	21	34·2	39·0	— 4·8	3
1860.								
January . .	55·6	19·0	36·6	15	37·3	36·7	+ 0·6	26
February .	50·0	18·5	32·5	21	35·4	39·3	— 3·9	4
March . .	55·0	21·0	34·0	11	40·0	41·8	— 1·8	11
The 6 months together	73·0	0·5	64·5	88	39·4	41·6	— 2·2	

CHEMICAL SOCIETY, *Thursday*, 3 *May*.

PROFESSOR BRODIE, *F.R.S. in the Chair.*

WILLIAM PROSSER, Esq. was elected a fellow. Dr. GLADSTONE delivered a discourse *On Circular Polarisation*. (This will appear in an early number.) The next meeting will take place on Thursday May 17, when papers will be read by Mr. WANKLYN *On Zinc Methyl*, and by Dr. GUTHRIE *On some Compound of the Olefines*.

NOTICES OF PATENTS.

Waterproofing, Cementing, and Stiffening Fabrics.

DR. SCOFFERN.

DR. SCOFFERN, like many other chemists, has endeavoured to turn to account the curious property which ammoniacal solutions of certain oxides have in dissolving vegetable and animal fibre. "Copperised ammonia" is the solvent employed by the patentee. It dissolves "woody fibre, paper, cloth, and other forms of lignine; it also dissolves wool, feathers, and hair, also silk, and many other animal and vegetable fibres or materials."

The patentee employs solutions of these kinds to stiffen cloth, paper, silk, and flannel, or as a cement for sticking sheets of any fabric together. The solution of silk in the cupreous solvent having a lustrous black colour, it may be employed in varnishing cloth, paper, &c. The patentee also claims the use of a solution of any animal substance in cupreous ammonia as an animalising medium in mordanting vegetable fabrics for the reception of those dyes which only take well upon animal surfaces.

This last feature is of great importance if it really succeeds. Numerous chemists have most laboriously worked upon the animalising of cotton tissues, but hitherto, as is well known, albumen and lactarine are the only substances which have yielded good results. It is true that gluten has been employed by Mr. Crum, but we doubt if it will answer in practice. We have ourselves experimented upon gluten in this direction, long ere seeing the results of Mr. Crum, but we confess to arriving at the conclusion that in the present state of chemistry albumen was by far the best nitrogenous mordant for printing on the new purple and pink colours.

Improvements in preparing Resins. HUNT and POCHIN.

THIS patent is partly for distilling turpentine *in vacuo*, and partly for an improved method of preparing "virgin resin." As the process is a valuable and important one, we shall give a condensed account of it. The principle consists, mainly, in filtering the crude turpentine (previous to distillation with steam *in vacuo*) at as low a temperature as is consistent with sufficient fluidity.

As the heat must not rise above 100° F. the materials employed, if not sufficiently fluid at that temperature, must be thinned with spirits of turpentine until the requisite fluidity is secured. The materials are first strained through a coarse sieve of tinned copper, and then through a cloth sufficiently fine to retain all the impurities mechanically suspended in them. The filtered turpentine is then to be distilled in a current of steam *in vacuo*, until no more spirits of turpentine come over. The resin remaining in the still is almost colourless, and fit for employment in all cases which demand the use of virgin resin.

The practical simplicity and the commercial importance of the process developed in this patent are so obvious as to require no comment.

CORRESPONDENCE.

Titanium in Iron Ore.

To the Editor of the CHEMICAL NEWS.

33 Gold Street, Northampton.

SIR,—Some time since Mr. Stenson, a gentleman extensively connected with the iron trade in this town, brought me some samples of titanic iron ore and also some New Zealand iron sand, and as I was aware he had been interested some years since in the latter, I forwarded him my copy of the CHEMICAL NEWS containing Mr. Mushet's article for perusal.

I consider the reply he sent me after reading it contains much useful and valuable information respecting the New Zealand sand, and I have, with his permission, enclosed to you a copy of his letter to me for insertion in your journal, if you think it will interest your readers.—I am, &c.

WM. H. HARRIS.

"Patent Iron Scrap Forge Works, Northampton.

"DEAR SIR,—I am obliged by you sending me the CHEMICAL NEWS in which I have read Mr. Mushet's interesting account of the New Zealand iron sand; the article is well written, and contains much that is true and useful, but is not without a few errors also. The presence of titanium in iron ore is doubtless one of its chief elements of excellence when its metallic products are converted into steel, but Mr. Mushet is by no means the first to discover that the ore in question contains titanium, or that there is a similarity between the iron sand of New Zealand and the rich ores of Sweden and Russia, as I myself, among others, have been aware of the fact for many years past. I have said and written it some ten years ago, and in one of my letters which afterwards appeared in the *Taranaki Herald*, published in New Plymouth (where the ore covers the sea beach for some miles), I called it *steel ore*, from its peculiar adaptation to the production of the best steel, adding that steel could be produced from that ore equal to the best brands of Russia or Sweden, for I well knew it to be a kindred ore to those most celebrated in the north of Europe, though the latter is excavated from the rock *in situ*, while the former is the beach sand of a rough and open roadstead. Both belong to the primitive formation, are equally attracted by the magnet, are alike refractory in smelting, and hold in combination titanic acid.

"So certain was I as to the excellence of this ore, that I sent to New Plymouth and obtained, through the kind assistance of Messrs. Willis and Co., ten tons, a small portion of which I reduced, several lots I sent to others for experiment, and the remainder is at our works at this time. In working this ore success will not be obtained without difficulty, for all ores containing titanium are less fusible than others: even in my experiments in the assay furnace I frequently found the bottoms and sides of the crucibles attacked by this very refractory ore, until a hole was made through which the assay escaped; the remedy was obvious, and by adding more carbonate of lime and other reducing fluxes success was so far obtained that iron of various qualities could be produced at will, a soft malleable iron resulting from one assay, and from another a fine grained silvery steel, which when made into a chisel could cut any other steel in our possession. I had intended pro-

secuting the manufacture of iron and steel from this ore in the colony some eight or ten years ago, but an extending business of importance here and other reasons prevented my further attention to the subject. I may mention also that the so-called discovery of Mr. Mushet when referring to a few other iron ores (in England) as containing titanium, is not quite new, as I have often examined the cinders from the bottom of blast furnaces when blown out for repairs, and have in no single instance failed to obtain the well known copper-coloured cubic crystals of metallic titanium, or rather those composed of nitride and cyanide of titanium, intermingled and distributed throughout such cinders, *i. e.* where the furnace has been some years at work. Not that any of our carboniferous iron ores contain titanium in sufficient quantity as to insure a steel of superior excellence, but that the titanic iron sand of New Zealand does contain the required percentage has been known for some years past.

"I observe that the editor of the CHEMICAL NEWS has a note on p. 238 respecting the process patented by Mr. J. P. Farrar, for using ferrocyanide of potassium and sal ammoniac in making steel. He takes a chemical view of the probable effects resulting from the use of these two substances; how easily chemists may err when treating of so difficult a subject as metallurgy. I have seen and tested steel made in accordance with that patent, and found it a useful article and valuable for many purposes in the engineering establishments of the country.

"There is yet a wide field open for improvements in the manufacture of iron and steel. This thing at least is clear, viz. that little, if anything, is known of the great changes which may be induced by the admixture of other matters with iron, and especially by some whose electric and electro-galvanic conditions vary in quality or degree with that metal. With all respect to chemical science, it has done but little hitherto for the iron trade, and we may almost say of it as the miner said of geology: "That mining had done more for geology than geology had done for mining." Chemistry, however, is the science, when practically applied, from which we may fairly expect to derive important aids in those researches so essential to the development of further discoveries, and to the perfecting of manufactures of such importance as the iron and steel manufactures of Great Britain.—I remain, Yours truly, Jos. STENSON.

"Mr. W. H. HARRIS."

Latent Heat.

To the Editor of the CHEMICAL NEWS.

SIR,—On looking over my remarks upon this subject, I have considered it necessary to explain more perfectly what I understand by the absorption of heat.

Supposing heat to be merely the continuous friction of some ether, it is not possible to apply the term absorption to it in precisely its usual sense. Vapour is said to be absorbed by the atmosphere, and vapour is a something, whereas friction is only the condition of any substance. By the absorption of heat I mean the counteraction, the partial or complete cessation, of the friction of some ether. When heat diminishes, I therefore suppose that this friction is, to a certain extent, counteracted by the vibratory motion of some body or bodies. Analogy supports this consideration, or, I should rather say, the opinion of many philosophers on a like subject is analogous to this, inasmuch as I would not take for granted, and therefore set forth as an analogical fact, an unproved supposition, however probable. It is, I think, at the present period, a general opinion among the philosophical community, that the darkness in some cases produced by the meeting of the solar rays is owing to the harmonious union of the luminous waves, the truth of the undulatory hypothesis being here supposed, and moreover thought to be, perhaps, in the greatest degree confirmed by this phenomenon. If this doctrine is accepted, I think it will be acknowledged to bear favourably upon what has been remarked respecting that phenomenon of heat at present considered.

The phenomena of vision appear to me analogously favourable to the doctrines of heat and sound which have been set forth. That vision is ultimately, by which I do not mean as regards perception, nothing but the condition of vibration, is all but, if not absolutely, proved, by the perception experienced after the eye has been turned from brilliant objects, and the phenomena of complemental colours. I do not deny that light is the friction of some element, all I say being, that the condition of friction, *per se*, constitutes vision. It is true that this friction must be different in kind to that producing either heat or sound, and I apprehend that no objection to the supposition can on this account be urged. And this remark of course applies to the other manifestations. The vibratory condition here supposed to constitute light, appears to me confirmed by the observation of Mr. Maskelyne, given in his Lecture on Diamonds, respecting the luminosity of a diamond when taken from under a beam of electric light. Probably the diamond was thrown into that peculiar state of vibration, which, by rightly affecting the luminous element, which I take to surround us continually, produced upon the eye that species of friction which can affect it, and man knows as light. The frictions by all acknowledged to play some part in the perceptions of heat and sound, do not affect the eye, thus proving that it is not susceptible to every species of vibration. Although the sun must be supposed rightly to affect some ether, that is, granting the undulatory hypothesis, there is not, to my mind, any reason for supposing that this daily proceeds from it. We may, I take it, imagine a visual element constantly surrounding us. It appears to me probable that heat and light, and perhaps electricity and its kindred forces, are but the various frictional conditions of one surrounding element, inasmuch as this, to appearance, more tallies with the general economy of nature. Although the causes producing heat and sound do not affect the eye, it is found that a species of friction exercised upon it by the hand produces concentric rings of various colours, which proves that light may artificially be produced. And it is as common an observation that light is seen when the eye is heavily struck; and this phenomenon demonstrates, perhaps with superior potency, the same thing as the former does.—I am, &c. J. A. DAVIES.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

On the Changes of Volume Salts undergo in Dissolving.—The real density of saline solutions is always higher than the calculated. M. Tissier[1] has determined the contraction of volume which takes place with several salts. He first took the density of a saturated solution containing an admixture of some undissolved salt in powder, taking care to have all the air removed by stirring well with a platinum wire; and then he carefully added just enough water to effect the complete solution. The following were the results obtained with the under-mentioned salts:—

Solutions.	Calculated Density.	Real Density.
Nitrate of Potash	1·0615	1·0800
Chloride of Sodium	1·0776	1·1014
Sulphate of Magnesia	1·0936	1·1218
Sulphate of Iron	1·0643	1·0845
Chloride of Barium	1·1099	1·1392
Phosphate of Soda	1·0370	1·0500
Cane Sugar	1·0975	1·1026

The author does not believe this contraction to be an indication that the solution is a chemical combination; but asserts that the liquefaction of the salt is the sole cause of the diminution of volume.

II. ORGANIC CHEMISTRY.

Products of the Fermentation of Mucic Acid. M. Rigault observes[2] that between citric and mucic acids there exist very remarkable relations: The two bodies have

[1] *Journal de Pharm. et de Chim.* t. xxxvii. p. 285.
[2] *Comptes-Rendus*, t. l. p. 782.

an almost identical composition, mucic acid having the same elements as citric acid, crystallised with two equivalents of water. Besides this when submitted to the action of potash in a state of fusion, both are decomposed and form 1 molecule of oxalic acid and 2 molecules of acetic acid, which seems to indicate that not only are their elements almost the same, but that they are similarly arranged. Personne has shown that under the influence of a ferment, citrate of lime is converted into acetate and butyrate of lime, which M. Rigault finds to be the case with mucate of lime. He fermented mucate of lime (using muscular flesh as the ferment), at a temperature varying from 25° to 35° C. The gases given off were carbonic acid and hydrogen, the proportion of the latter constantly varying. After six weeks the evaporated liquor treated with sulphuric acid, yielded acetic and butyric acids, and perhaps a very small quantity of metacetic acid. Supposing the products of the metamorphosis of mucic acid to consist entirely of acetic and butyric acids, the reaction will be expressed by the following equation:

$$3(C_{12}H_{10}O_{16}) = 3(C_4H_4O_4) + C_8H_8O_4 + 16CO_2 + 10H.$$

The small proportion of butyric acid, however, and its late appearance among the products, induces the author to suppose that this is not an essential product, but the result of an accessory fermentation which goes on parallel with the principal phenomenon, and is determined by an altered portion of the ferment, and then the equation will be:

$$2(C_{12}H_{10}O_{16} = 4(C_4H_4O_4) + 8CO_2 + 4H.$$

The identity of the products of the fermentation of mucic and citric acids, justifies the opinion which attributes to these two bodies a similar molecular constitution, and strengthens the hope that citric acid may one day be obtained in the laboratory by a process analogous to that which gives mucic acid.

Oxide of Amylene.—M. Bauer[3] has obtained oxide of amylene by a process analogous to that used by Würtz to obtain oxide of ethylene. He mixed the liquid obtained by the action of hydrochloric acid on amyl-glycol, with a solution of potash. The action was violent: after having neutralised the free hydrochloric acid by the first additions of potash, he remarked, on adding more potash, the production of a volatile liquid, most of which, when submitted to distillation, passed about 95°. The analyses of several specimens gave results which agree with the formula $C_{10}H_{10}O_2$. The formula was confirmed by the determination of the density of the vapour taken at 167°, and calculated for a condensation of 4 volumes.

Oxide of amylene burns easily and with a yellow flame, has an agreeable odour and a rough taste. It dissolves in alcohol and ether, but not in water. Acids mix with it. Anhydrous nitric acid combines with it when the two are heated together.

III. CHEMICAL ANALYSIS.

Fluorine in Water.—To detect this, M. Ch. Mène treats the solid residue of a large quantity of the water with an excess of concentrated sulphuric acid, and passes the gaseous products into water slightly ammoniated, in which, if fluorine was present in the water, some gelatinous silica is obtained, resulting from the decomposition of the fluoride of silicon which was disengaged from the residue.

IV. TECHNICAL CHEMISTRY.

Manufacture of Beet-root Sugar.—M. Pésier,[4] has introduced a method of defecating the juice of beet-root by means of alcohol. He employs two volumes of alcohol to one of the juice. This quantity so completely precipitates the albuminous and the colouring matters that the use of animal charcoal in refining the sugar is rendered unnecessary. The loss of alcohol in the process is so small as to represent only one-fifth of the value of the animal charcoal which is dispensed with.

[3] *Journ. de Pharm. et Chim.* April, 1860.
[4] *Cosmos.*

MISCELLANEOUS.

Titanium in Iron Ore.—Mr. Robert Mushet writes to the *Engineer*—"I have known for many years that certain of the Lowmoor minerals contain such an amount of titanic acid as to confer upon the iron manufactured from them the well known excellence of the Lowmoor make, and that any ironmaster who will be at the trouble to add a mixture of titanium ore to the burden of his blast furnace, will thereby be enabled not only to rival but to surpass the quality of Lowmoor iron. The question is simply this—whoever wishes to make the best iron must add the largest proportion of titanium ore to the burden of his blast furnace, being careful, however, to introduce nothing which tends to counteract the effect of the titanium alloy, such as materials containing phosphorus, sulphur, and an excess of lime."

Antidote for Chlorine.—M. Bolley has observed that while occupied in researches upon the violet of aniline he suffered no inconvenience in atmospheres charged with chlorine, and that the mucous membrane of his nostrils was tinged violet blue. Experience confirmed his impression that these effects were due to the inhaling a small quantity of the vapour of aniline. Two young persons in the laboratory, overcome by chlorine, obtained relief by breathing the vapour of aniline exhaling from an aqueous solution of that alkaloid. M. Bolley therefore confidently recommends aniline as a prophylactic or antidote against the deleterious effects of chlorine.—*Répertoire de Chimie.*

Poisoned Perfumes.—The police of Paris have been for some months engaged in the examination of a variety of falsifications, and among the rest that of perfumery. Several actresses have been suffering from the effects of poison absorbed from the face, without suspecting that their sufferings came from this source. The quantity of corrosive sublimate, arsenic, verdigris, vitriol, and other poisonous substances daily absorbed in Paris must in effect be immense, and the reform did not commence too soon. The investigation was instigated by an actress of the Variétés Theatre against a perfumer for damages for indisposition attributed to his cosmetics.

Copper Tubes made by Galvanic Process.—*Le Génie Industriel*, publishes the details of a process for making copper tubes without soldering, which consists simply in depositing copper upon lead patterns by the galvanic battery, and then melting out the lead. It is said to work perfectly, and of course, tubes could be made of any desired form—straight, curved, or right-angled. This suggests the idea of forming tubes in the same manner with cores of wax or clay. The clay may be forced into the size of the pipe through a draw plate, then allowed to harden slightly, when it may be covered with plumbago and an electro deposit of copper made upon it with a galvanic battery. When the copper is deposited in sufficient thickness the clay may be removed from the interior by boiling the pipe in water. To conduct this manufacture it would require long depositing troughs, and the expense would probably be too great for making straight copper tubes; but for curved tubes, such as the worms of stills, it would perhaps pay. Curved copper tubes are commonly made by filling straight tubes with hot resin, then twisting the entire tube into its curved form. When the resin becomes cool it is driven out by striking the pipe, which breaks the resin core into small pieces.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

F. F. S.—No—in French. It will shortly appear in the Chemical News.

A Subscriber.—Sulphovinate of potash is of course a compound of sulphovinic acid and potash. For the mode of preparing it we must refer our correspondent to a work on chemistry.

A. K.—A thorough fumigation by burning sulphur inside, and then washing well with boiling water, we believe would answer.

A.R.W.—We know of no work specially devoted to the subject, but receipts are to be found in many—Art of Perfumery, by S. Piesse, Manufacture and Use of Perfumery, by C. Morfit. 7s. 6d. each.

H.H.—We are not aware of any.

M.A.B.—Received with thanks.

Received—Chrysalis—J. Oyston. Answers next week.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Silver, by FREDERICK FIELD.

THE separation of silver by the well known method of cupellation, although almost universally adopted in the examination of minerals and other metallurgic products, has been greatly superseded in the valuation of ingot silver by the excellent process introduced many years ago by M. Gay-Lussac. This method is so familiar to all, and its results are so fully established, as to render any remarks superfluous. It consists essentially of solution of the silver in nitric acid, and precipitation of the metal as chloride, by means of a standard solution of chloride of sodium.

Although excellent in the estimation of silver in ingots, coinage, &c. it is inapplicable in the case of several alloys, and altogether inadmissible in the assay of most minerals. It is a process almost exclusively confined to the Mint or to the silver refining, and fully answers the purpose for which it was proposed.

In the case of some minerals, it appears very difficult to devise any means for the extraction of the silver by any other method than that commonly known as the *dry* process. In the chlorides, chlorobromides, and iodides, for example, recourse must be had to the crucible. The two former varieties exist in very large quantities in South America, no inconsiderable portion of the silver imported into England from that continent being derived from these ores. They resist the action of all acids, the only solvents being ammonia and hyposulphite of soda, and although the artificially prepared compounds of chlorine and bromine dissolve in these menstrua, the native minerals require a most prolonged action, and after all the results are far from satisfactory. When it is considered that the loss of $\frac{1}{100}$ of a grain of metal in 100 grains of ore is equal to three ounces and a quarter of silver to the ton of mineral, it can easily be conceived that all operations should be simplified and shortened as much as possible, to avoid the liability of the very serious errors which may easily occur.

Were it not for the slight loss of silver which invariably takes place in the process of cupellation, both by absorption in the cupel and by volatilisation in the fumes of the lead, the process might be considered as one of the most satisfactory in chemistry, the filtration, as it were, of all impurities, and the residue chemically pure metal, immediately ready for the balance. But many thousand experiments have proved that there *is* a loss, and compensation tables have been constructed, showing very nearly the amount of that loss, giving the quantity of silver which must be added to that obtained, in order to arrive at the truth, and although, independently of the greater or less excess of lead, loss may be partially avoided by the skill of the manipulator, knowledge of the furnace and proper regulation of temperature, the most successful operator cannot altogether avoid the absorption and volatilisation which appear to be concomitants of the process.

From some experiments performed in the metallurgic laboratory of the school of mines upon the loss of silver by cupellation, two important facts seem to be fully confirmed, first, "that according to the decrease of the silver cupelled, so the loss of that metal very slightly increases, provided the ratio of lead employed be constant," and second, "that an increasing ratio of lead produces an increasing loss of silver." Mr. Hambly, the author of the experiments referred to, gives us the results of several cupellations in proof of this. For instance, with regard to the first conclusion, when 25 parts of silver are cupelled with ten times their weight of lead (250 parts) the loss of the former is 1·05 per cent. When ten parts are cupelled with 100, the loss is 1·10 per cent. and with one part to ten 1·20 per cent. With reference to the second conclusion, Mr. Hambly's experiments showed that when the proportions of lead and silver are as 1 to 1, the percentage loss is 0·55; when 10 to 1, 1·52; when 20 to 1, 1·68; and 35 to 1, 1·88 per cent.

These researches were made, however, upon the pure metals, when other metals (as is usually the case) exist in the alloys the results are somewhat different.

Mr. Napier, of the Mexican Mint, in two very interesting memoirs upon the action of heat on gold and its alloys with copper, and upon deposits in the chimneys of furnaces used for the fusion of the precious metals, communicated to the Chemical Society (vols. x. and xi.) proves very satisfactorily that on heating an alloy of gold and copper to the fusing point the volatility of the former metal is owing in a great measure to the presence of the copper, and from the analyses of the deposits in the chimneys there can be little doubt that a great part of the silver volatilised was evolved in combination with the same metal. From my own experiments, I am convinced that the presence of copper exercises a most material influence upon the loss of silver in cupellation, and my ideas have been fully confirmed, not only by several French chemists, but by the very extended investigations of M. Domeyko, Professor of Chemistry and Mineralogy in the University of Santiago de Chile.

In the estimation of silver in the double sulphide of that metal with copper the loss is very apparent. Many varieties of these sulphides exist, containing from 20 or even 30 per cent. of silver to one or two tenths of a per cent. Of course the great bulk are of the latter description, those containing from 20 to 50 ounces of silver per ton of mineral. Consisting principally of sulphide of copper, the amount of lead necessary for the cupellation is very large, and contains, after fusion with the mineral, a considerable quantity of copper. The loss of the precious metal was at times so striking as to compel me to abandon the usual method, and to adopt more or less both the wet and the dry process. There is nothing particularly novel in the mode of proceeding, but as very accurate and trustworthy results were obtained it will be briefly described. The finely powdered mineral is dissolved in strong nitric acid until the sulphur is yellow,

the solution somewhat largely diluted with water and one or two drops of hydrochloric acid added. After treating gently and allowing to rest until the supernatant liquid is clear, the residue consists of earthy insoluble matter and chloride of silver. After filtration the filter is dried, and the greater part of its contents mixed in a mortar with carbonate of soda, a small quantity of litharge, and a few grains of bitartrate of potash. About half the mixture is put in a crucible, and the filter is then folded up and placed upon the powder, the remainder of which is now introduced, and the whole covered with a little fused borax. It is preferable to burn the filter in this manner by the heat of the furnace, under a layer of carbonate of soda and litharge, than to consume it by a lamp, and mix the ashes with the flux, as the chloride of silver being so highly volatile some might be lost by the application of the flame, providing no reducing agent were in contact. It may be remarked that many of the native sulphides are difficultly acted upon by nitric acid, and require the stronger energy of aqua regia. I am aware of this, and have tried numerous experiments upon the subject, but have invariably found the use of nitric acid and the subsequent introduction of a very small quantity of hydrochloric acid or chloride of sodium to be preferable.

Chloride of silver is very soluble in hot solution of chloride of copper, a fact easily proved by the precipitate produced by the addition of water to the solution, and even in the cold traces of silver can be detected. At any rate a long time must elapse before the liquid can be filtered with safety. If, after ebullition and introduction of water, filtration is immediately resorted to, the error in the quantity of silver is of considerable importance. Should the operator be desirous of avoiding cupellation altogether, he can obviate it by the employment of perfectly pure nitric acid, after satisfying himself that no soluble chlorides exist in the mineral either accidentally or otherwise. Even if this be the case he can extract them by a preliminary digestion in water. In the entire absence of chlorine the whole of the silver is necessarily in solution in the nitric acid, and can be filtered from the matrix, precipitated as chloride, and estimated as such. The plan originally proposed, however, is the safer, as, providing no trace of soluble chloride exist, it is very possible, nay, even probable, that traces of oxychloride of copper (atacamite) may be associated with the sulphide, in which case, after digestion in nitric acid, all the silver will remain with the residue, and will be therefore overlooked.

In metallurgical processes, generally considered, there can be no doubt that the greatest number of cupellations are effected in those establishments devoted to the extraction of silver from argentiferous galena, and as the native sulphide of lead is associated with comparatively small amounts of copper the errors of the cupel are not augmented by any contingent circumstances. And, moreover, as the silver itself in the large way is obtained by cupellation, the result of the smaller experiment may be regarded as a very fair illustration of the truth, that is to say, the silver derived from a few grains of ore and also from many tons should exactly correspond. M. Mène[1] has, however, in this class of experiments endeavoured to avoid cupellation by adopting the humid process. About 20 grammes of the substance to be analysed are boiled with nitric acid diluted with three or four times its volume of water. The filtered liquid is precipitated by a considerable excess of ammonia, and then again rapidly filtered. By this means the oxides (lead, &c.) insoluble in ammonia are separated from those soluble in that alkali. The addition of excess of hydrochloric acid to the filtrate throws down the silver as chloride, the other metals remaining in solution. M. Mène gives the results of many experiments proving the accuracy of the method, but when we consider the length of time necessary for thoroughly washing the precipitated oxide of lead, especially if the mineral be rich in that substance, from more than 300 grains of ore, and, moreover, the slight solubility of chloride of silver in chloride of ammonium, which must exist in very large proportion, the advantages of this process over the dry method, I think, are very doubtful. A series of experiments connected with the estimation of silver must be deferred to a future number.

[1] *Comptes-Rendus*, 1857.

On Circular Polarisation, by Dr. J. H. Gladstone, *F.R.S.*
(*A discourse delivered before the Chemical Society on Thursday, May* 3, 1860.)

The speaker commenced by expressing his intention, on account of the immense mass of materials before him, of omitting the purely physical part of his subject, and confining himself to those departments which have a direct bearing on chemical science. The property of circular polarisation was first observed by Arago in 1811; it was investigated by Biot, and speedily attracted the attention of physicists in this country; but though Brewster, Herschel, and Airy made early and important discoveries, very little had been done since by the scientific men of Great Britain, while in France and other parts of the continent investigations have rapidly extended, and this property of light has been applied to the solution of many chemical problems.

The leading phenomena of circular polarisation were stated to be,—the absence of the black cross when a slice of a crystal having this property is cut in a direction perpendicular to its axis, and examined by polarised light, and the production of different colours at different azimuths of rotation. If such a substance be placed between the polariser and analyser of a polariscope the maximum and minimum of light are not obtained when the plane of reflection is inclined to that of polarisation at 0° and 90°, but at other angles. The extent of this deflection differs with the colour, that is, the refrangibility of the ray; thus a violet ray will be deflected perhaps twice as much as a red ray, and hence when white light is employed a series of colours are observed following one another when the analyser is made to rotate. If in order to make these follow in their natural order—red, orange, yellow, green, blue, violet, it is necessary to turn the analyser to the right, the substance is said to exhibit right handed, or positive circular polarisation, if to the left it is called left handed or negative.

A list was then given of the substances which are known to exhibit this effect on the polarised ray, as far as the speaker could ascertain them, with the direction of the polarisation, the names of the first observers and of those who had subsequently extended our knowledge of the optical properties of the body in question, and whether they form hemihedral crystals. The substances are quartz, cinnabar, chlorate of soda, bromate of soda, acetate of uranium and soda (all three in the solid state) the oils of turpentine, lemon, bergamotte, anise, carraway, spearmint, rue, nutmeg, lavender, cubebs, valerian, and amber, castor oil, croton oil, balsam of Copaiva, camphor, camphoric acid, camphovinic acid, camphomethylic acid, formo-benzoic acid, sulphamylic acid,

amylic alcohol, naphtha, tartaric acid, tartramide, tartramic acid, malic acid, asparagine, aspartic acid, cane sugar, grape sugar, milk sugar, starch sugar, diabetes sugar, glucosate of sea-salt, quinine acid, quinine, quinidine, quinicine, cinchonine, cinchonidine, cinchonicine, quinoidine, morphine, strychnine, salicine, populine, codeine, narcine, picrotoxine, nicotine, santonine, hematoxyline, jalapine, phloridzine, brucine, narcotine, and albumen. Some of these, as the first five on the list, and tartaric acid and camphor with their derivatives, exhibit either right or left handed polarisation, according to the specimen examined. No attempt was made to express in the same table the rotatory force possessed by the various substances, not from any lack of numerical data, but because it has often been differently determined by different observers, on account partly of actual differences in the samples, and because unfortunately no uniform standard has been taken. Thus Biot reduces his observations according to the formula—

$$\rho = \frac{a}{d\,l}$$

in which a stands for the arc of rotation for the *red* ray, d the density, and l the length or thickness in millimetres; ρ being the rotating force. If the substance be dissolved in water or alcohol, the proportion present as well as the length of the solution must be taken into account. Wilhelmy, on the contrary, laying stress on the molecular nature of this force, considers it preferable to take the different substances in quantities proportional to their atomic weights in equal weights of the solvent; he makes his calculations also for *white* light, and assumes the molecular rotating power of cane sugar as 100. One of Wilhelmy's tables was given as an example of the elaborate investigations that have been made on this subject.

Influence of State of Aggregation.—Oil of turpentine is the only substance that has been examined in the three states solid, liquid, and gaseous. It rotates the plane of polarisation in each. Biot, for observing the vapour of turpentine, had to make use of an iron tube fifty feet in length, and unfortunately before he could determine the amount of rotation a burst of flame occurred, and gave rise to a conflagration which he could not extinguish without the assistance of the public. The existence of this optical force in other substances appears, however, to depend on the manner in which they are crystallised. Silicic acid is an example.

Influence of Temperature. — The rotatory power of quartz increases with heat; that of uncrystallisable sugar, on the contrary, decreases as the temperature rises to the extent of twelve parts in the 1000 for each degree. Tartaric acid varies with the temperature to such an extent that by means of cold it has been reduced with the solid acid to *nil*, and even to a rotation in the opposite direction. Salts of quinine, and many other substances are known to be affected by heat, but oil of turpentine is said to be the same at different temperatures, and even when frozen.

Faraday's discovery of the influence of magnetism on polarised light, whether passing through optically active or inactive substances was alluded to.

Influence of Solution. — This was stated to be of three kinds:

1st. Some substances, as chlorate or bromate of soda, or the double acetate of uranium and soda, exhibit circular polarisation only in the solid state. These substances, therefore, like quartz, appear to owe this property to the manner in which their molecules are arranged in the crystals.

2nd. Other substances, all organic, exhibit the same rotatory power, whether in the solid state, or dissolved in some neutral solvent, such as water or alcohol. Thus barley sugar, and the same sugar dissolved in any proportion of water. Oil of turpentine also belongs to this class. In such cases the substance seems to owe its optical power to the very structure of its molecules.

3rd. Other substances again give a result partaking of both these characters, as though the individual action of the molecules were accompanied in the solid state by another action arising from their regular arrangement. Thus, according to Descloizeaux, sulphate of strychnine crystallised with 13 atoms of water rotates the plane of polarisation 24 or 25 times more than the same salt in solution. The curious observations of Arndtsen on tartaric acid and on camphor dissolved in alcohol were referred to.

Influence of Chemical Combination. — In most cases this property is so intimately connected with the structure of the molecule itself, that it is little affected by chemical changes of an important character. Thus an optically active acid carries its power of rotating the plane of polarisation into its salts, and the same remark will apply to an optically active base. Yet the amount of rotation is generally affected by this combination, and sometimes (as in the case of some malates) the direction is reversed. The conversion of an acid into an amide, and that again into an amidogen acid, does not destroy the power of acting on a polarised beam, as is shown by tartaric acid, tartramide, and tartramic acid, or by malic acid, asparagine, and aspartic acid. Oxidation and the substitution of a compound radical for hydrogen also do not destroy it, as is seen by the optical power of camphor, camphoric acid, and camphovinic or camphomethylic acid. There is, of course, some amount of chemical change which must be fatal to the retention of this power: in the case of malic acid this is arrived at when it is converted by heat into fumaric acid, and what is well worthy of notice, the asparagine and malic acid prepared not from the plant, but from fumarate of ammonia, are themselves optically inactive. We have no evidence that an active substance has ever been prepared artificially from an inactive one; the tartaric acid which Liebig has recently prepared rotates polarised light like the ordinary acid, but then it was made from milk-sugar, which is itself active. It will be interesting to determine whether the tartaric acid which Perkins has just prepared from succinic acid, displays this property. From its belonging to the same series as tartaric and malic acids, it might be supposed that succinic acid itself would affect the plane of polarisation, but the speaker stated that he had found it to be perfectly inactive.

Relation between Crystalline Form and Circular Polarising Power. — As far back as 1820, Herschel found that the crystals of right-handed and of left-handed quartz differ from one another in the inclination of certain facets, but it was reserved for Pasteur to show that this relation between crystalline form and rotatory power is one that generally obtains. It will sometimes happen that a substance will crystallise in two forms which are both unsymmetrical, but unsymmetrical in opposite directions, the one appearing identical with the other, when looked at in a mirror. They differ in the same way as our two hands differ from one another. Such crystals are variously called non-superposable, incongruous, or opposite hemihedra. The remarkable series of discoveries which Pasteur was enabled to make on racemic and tartaric acids, from observing the opposite hemihedral character of certain crystals of racemate of

soda and ammonia were referred to, but not described, as they are well known to English chemists, but his subsequent researches in the same direction were treated at greater length. He finds that active and inactive bodies, however isomeric, will not crystallise together, and that it is a general law that where a substance crystallises in opposite hemihedra, it indicates the existence of two opposite powers of rotation, and *vice versâ*. This is, however, not a universal law, as formiate of strontia proves on the one hand, and the salts of sulphamylic acid on the other.

Chemical Applications of Circular Polarisation.—These were grouped under three heads:

1st. Quantitative estimation of organic substances in solution.

As cane sugar rotates the ray irrespective of the amount of water in which it is dissolved, or of the presence of inactive substances, this property has frequently been made use of for quantitative determinations.

The experiments of Clerget and others, and the many instruments devised for the purpose, were referred to, and Dr. Gladstone then drew attention to two polariscopes on the table, the one a Soleil's saccharometer, the property of Dr. Bence Jones, the other a modification of Biot's instruments by Mr. Heisch. In the latter case the polariser consists of a Nicoll's prism and a plano-convex lens; the tube for holding the solution is very narrow, made of black glass ground inside with emery, and fitted at each end with covers of parallel glass; the analyser consists of a small aperture, or lens, and a prism of doubly refracting spar; and it is attached to the vernier of a graduated circle. If when the index of the scale is at 0° and the extraordinary image at its greatest obscurity, a solution of sugar be placed in the intermediate tube, it is easy to determine how much the analyser must be now turned to bring the extraordinary image to its greatest obscurity, or rather to the "sensitive tint." Some details were entered into, especially with reference to the ingenious method of confirming the direct observation by converting the cane sugar by means of acid into uncrystallisable sugar, which has an inverted or left-handed rotation. This process also serves to determine the amount of cane sugar when mixed with glucose or other right-handed sugars. Boiling with potash may also be employed for that purpose.

Other sugars have been quantitatively determined in like manner, and reference was made to published analyses of the grape sugar in the wines of commerce, of the sugar in milk, and of that in diabetic urine.

The percentage of sugar may be determined by the following formulæ, given on the authority of Heisch, in which a represents the arc of rotation for lamp light, and l the length in *inches*.

Cane sugar . . . . $p = 6{\cdot}09\ \frac{a}{l}$

Inverted sugar . . . $p = 16{\cdot}026\ \frac{a}{l}$ at 15° C.

Diabetes sugar . . . $p = 8{\cdot}346\ \frac{a}{l}$

In a similar manner A. Becquerel has determined the amount of albumen in the serum of the blood.

2nd. Determination of what is going forward in a solution.

The variations of the plane of polarisation will often indicate changes that could not be otherwise observed. In proof of this were cited Biot's investigations on the combination of tartaric and boracic acids, and on the question of solution in general; the speaker's application of some experiments by Bouchardat to the further illustration of the reciprocal decomposition of binary compounds in solution; and Béchamp's observation that crystallised starch sugar when dissolved in water gradually loses the water with which it was combined.

3rd. Examination of isomeric substances.

Besides the different tartaric acids, Pasteur has investigated by this means the isomeric cinchona alkaloids, and has discovered two amylic alcohols. The application of circular polarisation to the distinguishing of different essential oils was referred to, and the experiments of Berthelot on a modification of the oils of turpentine and lemons were described. The speaker concluded with expressing his belief that circular polarisation would play no unimportant part in the chemistry of the future.

PHARMACY, TOXICOLOGY, &c.

On the Arsenic Eaters of Styria, by CHARLES HEISCH, *Esq. F.C.S. Lecturer on Chemistry at the Middlesex Hospital Medical College.*

AT the last meeting of the Manchester Philosophical Society I observe that Dr. Roscoe called attention to the arsenic eaters of Styria. Having for the last two years been in communication with the medical men and other residents in the districts where this practice prevails, I shall feel obliged if you will allow me through your journal to make known the facts I have at present collected. The information is derived mainly from Dr. Lorenz, Imperial Professor of Natural History, formerly of Salzburg, from Dr. Carl Arbele, Professor of Anatomy in Salzburg, and Dr. Kottowitz, of Neuhaus, besides several non-medical friends. If human testimony be worth anything, the fact of the existence of arsenic eaters is placed beyond a doubt. Dr. Lorenz, to whom questions were first addressed, at once stated that he was aware of the practice, but added, that it is generally difficult to get hold of individual cases, as the obtaining of arsenic without a doctor's certificate is contrary to law, and those who do so are very anxious to conceal the fact, particularly from medical men and priests. Dr. Lorenz was, however, well acquainted with one gentleman, an arsenic eater, with whom he kindly put me in communication, and to whom I shall refer again more particularly. He also says that he knows arsenic is commonly taken by the peasants in Styria, the Tyrol, and the Salzkammergut, principally by huntsmen and woodcutters, to improve their wind and prevent fatigue. He gives the following particulars:—

"The arsenic is taken pure in some warm liquid, as coffee, fasting, beginning with a bit the size of a pin's head, and increasing to that of a pea. The complexion and general appearance are much improved, and the parties using it seldom look so old as they really are, but he has never heard of any case in which it was used to improve personal beauty, though he cannot say that it never is so used. The first dose is always followed by slight symptoms of poisoning, such as burning pain in the stomach and sickness, but not very severe.

"Once begun, it can only be left off by very gradually diminishing the daily dose, as a sudden cessation causes sickness, burning pains in the stomach, and other symptoms of poisoning, very speedily followed by death.

"As a rule, arsenic eaters are very long lived, and are peculiarly exempt from infectious diseases, fevers, &c. but unless they gradually give up the practice invariably die suddenly at last.

"In some arsenic works near Salzburg with which he is acquainted, he says the only men who can stand the work for any time are those who swallow daily doses of arsenic, the fumes, &c. soon killing the others. The director of these works, the gentleman before alluded to, sent me the following particulars of his own case. (This gentleman's name I suppress, as he writes that he does not wish the only thing known about him in England to be the fact that he is an arsenic eater; but if any judicial inquiry should arise which might render positive evidence of arsenic eating necessary, his name and testimony will be forthcoming):—

"'At seventeen years of age, while studying assaying, I had much to do with arsenic, and was advised by my teacher, M. Bönsch, Professor of Chemistry and Mineralogy at Eisleben, to begin the habit of arsenic eating. I quote the precise words he addressed to me:—'If you wish to continue the study of assaying, and become hereafter superintendent of a factory, more especially of an arsenic factory, in which position there are so few, and which is abandoned by so many, and to preserve yourself from the fumes, which injure the lungs of most, if not of all, and to continue to enjoy your customary health and spirits, and to attain a tolerably advanced age, I advise you, nay, it is absolutely necessary, that besides strictly abstaining from spirituous liquors, you should learn to take arsenic; but do not forget, when you have attained the age of fifty years, gradually to decrease your dose, till from the dose to which you have become accustomed you return to that with which you began, or even less.' I have made trial of my preceptor's prescriptions till now, the forty-fifth year of my age. The dose with which I began, and that which I take at present, I enclose; they are taken once a day, early, in any warm liquid, such as coffee, but not in any spirituous liquors.' The doses sent were No. 1, original dose, three grains; No. 2, present dose, twenty-three grains of pure white arsenic in coarse powder. Dr. Arbele says this gentleman's daily dose has been weighed there also, and found as above. Mr. —— continues:—'About an hour after taking my first dose (I took the same quantity daily for three months), there followed slight perspiration with griping pains in the bowels, and after three or four hours a loose evacuation; this was followed by a keen appetite and a feeling of excitement. With the exception of the pain, the same symptoms follow every increase of the dose. I subjoin, as a caution, that it is not advisable to begin arsenic eating before the age of twelve or after thirty years.' In reply to my question, if any harm results from either interrupting, or altogether discontinuing the practice, he replies, 'Evil consequences only ensue from a long continued interruption. From circumstances I am often obliged to leave it off for two or three days, and I feel only slight languor and loss of appetite, and I resume taking the arsenic in somewhat smaller doses. On two occasions, at the earnest solicitations of my friends, I attempted entirely to leave off the arsenic. The second time was in January 1855. I was induced to try it a second time from a belief that my first illness might have arisen from some other cause. On the third day of the second week after leaving off the dose I was attacked with faintness, depression of spirits, mental weakness, and a total loss of the little appetite I still had; sleep also entirely deserted me. On the fourth day I had violent palpitation of the heart, accompanied by profuse perspiration. Inflammation of the lungs followed, and I was laid up for nine weeks, the same as on the first occasion of leaving off the arsenic. Had I not been bled, I should most likely have died of apoplexy. As a restorative, I resumed the arsenic eating in smaller doses, and with a firm determination never again to be seduced into leaving it off, except as originally directed by my preceptor. The results on both occasions were precisely the same, and death would certainly have ensued had I not resumed arsenic eating.' One of the most remarkable points in this narrative is that this gentleman *began* with a dose which we should consider poisonous. This is the only case of which I have been able to obtain such full particulars, but several others have been mentioned to me by those who knew the parties, and can vouch for their truth, which I will briefly relate.

"One gentleman, besides stating that he is well aware of the existence of the practice, says he is well acquainted with a brewer in Klagenfürth who has taken daily doses of arsenic for many years; he is now past middle life, but astonishes every one by his fresh juvenile appearance; he is always exhorting other people to follow his example, and says, 'See how strong and fresh I am, and what an advantage I have over you all! In times of epidemic fever or cholera, what a fright you are in, while I feel sure of never taking infection.'

"Dr. Arbele writes, 'Mr. Curator Kürsinger (I presume curator of some museum at Salzburg), notwithstanding his long professional work in Lungau and Binzgau, knew only two arsenic eaters, one the gentleman whose case has just been related, the other the ranger of the hunting district in Grossarl, named Trauner. This man was at the advanced age of 81 still a keen chamois hunter and an active climber of mountains; he met his death by a fall from a mountain height while engaged in his occupation. Mr. Kürsinger says he always seemed very healthy, and every evening regularly, after remaining a little too long over his glass, he took a dose of arsenic, which enabled him to get up the next morning perfectly sober and quite bright. Professor Fenzl of Vienna was acquainted with this man, and made a statement before some learned society concerning him, a notice of which Mr. Kürsinger saw in the *Wiener Zeitung*, but I have not been able to find the statement itself. Mr. Krum, the pharmaceutist here, tells me that there is in Stürzburg a well known arsenic eater, Mr. Schmid, who now takes daily twelve, and sometimes fifteen, grains of arsenic. He began taking arsenic from curiosity, and appears very healthy, but always becomes sickly and falls away if he attempts to leave it off. The director of the arsenic factory before alluded to is also said to be very healthy, and not to look so old as forty-five, which he really is.'[1]

"As a proof how much secrecy is observed by those who practise arsenic eating, I may mention that Dr. Arbele says he inquired of four medical men, well acquainted with the people of the districts in question, both in the towns and country, and they could not tell him of any individual case, but knew of the custom only by report.

"Two criminal cases have been mentioned to me, in which the known habit of arsenic eating was successfully pleaded in favour of the accused. The first, by Dr. Kottowitz of Neuhaus, was that of a girl taken up in that neighbourhood on strong suspicion of having poisoned one or more people with arsenic, and though circumstances were strongly against her, yet the systematic arsenic eating in the district was pleaded so successfully in her favour, that she was acquitted, and still lives near Neuhaus, but is believed by every one to be guilty. The

[1] The man above mentioned seems quite to differ with Mr. —— on the impropriety of taking arsenic with spirituous liquors, and actually employs it as a means of correcting their effects. All others that I have heard of concur in saying that it should be taken fasting.

other case was mentioned by Dr. Lorenz. A woman was accused of poisoning her husband, but brought such clear proof that he was an arsenic eater, as fully to account for arsenic being found in the body. She was, of course, acquitted.

"One fact mentioned to me by some friends is well worthy of note. They say: 'In this part of the world, when a graveyard is full, it is shut up for about twelve years, when all the graves which are not private property by purchase are dug up, the bones collected in the charnel-house, the ground ploughed over, and burying begins again. On these occasions the bodies of arsenic eaters are found almost unchanged, and recognisable by their friends. Many people suppose that the finding of their bodies is the origin of the story of the vampire.' In the *Medicinischer Jahrbuch des Oster: Kaiserstaates*, 1822, *neuest Folge*, there is a report by Professor Schallgruber, of the Imperial Lyceum at Grätz, of an investigation undertaken by order of government into various cases of poisoning by arsenic. After giving details of six post-mortem examinations, he says:—'The reason of the frequency of these sad cases appears to me to be the familiarity with arsenic which exists in our country, particularly the higher parts. There is hardly a district in Upper Styria where you will not find arsenic in at least one house under the name of hydrach. They use it for the complaints of domestic animals, to kill vermin, and as a stomachic to excite an appetite. I saw one peasant show another, on the point of a knife, how much arsenic he took daily, without which, he said, he could not live; the quantity I should estimate at two grains. It is said, but this I will not answer for, that in that part of the country this poison is used in making cheese; and, in fact, several cases of poisoning by cheese have occurred in Upper Styria, one not long since. The above-mentioned peasant states, I believe truly, that they buy the arsenic from the Tyrolese, who bring into the country spirits and other medicines, and so are the cause of much mischief.' This report is, I believe, mentioned in Orfila's *Toxicology*, and one or two other works, but I have not seen it quoted myself; it is interesting, as being early and official evidence of arsenic eating. Since I received the above information, a gentleman who was studying at this hospital, told me that, when an assistant in Lincolnshire, he knew a man who began taking arsenic for some skin disease, and gradually increased the dose to five grains daily. He said he himself supplied him with this dose daily for a long time. He wrote to the medical man with whom he was assistant, and I have been for a long time promised full particulars of the case, but beyond the fact that he took five grains of arsenic, in the form of Fowler's solution, daily, for about six years, and could never leave it off without inconvenience and a return of his old complaint, I have as yet not received them. I have delayed publishing these facts for some time, hoping to get information on some other points, for which I have written to my friends abroad; but as considerable delay takes place in all communications with them, I have thought it better to publish at once the information I have already received. All the parties spoken of are people on whom the fullest reliance can be placed, and who have taken much pains to ascertain the foregoing particulars. The questions which still remain unanswered are these:—

"1st. Can any official report be obtained of the trials of the two people mentioned by Drs. Kottowitz and Lorenz?

"2nd. Do medical men in these districts, when using arsenic medicinally, find the same cumulative effects as we experience here? Or is there anything in the air or mode of living which prevents it?

"3rd. Can any evidence be obtained as to how much of the arsenic taken is excreted? to show whether the body gradually becomes capable of enduring its presence, or whether it acquires the power of throwing it off?[1]

"I have proposed to the gentleman who furnished me with the particulars of his own case either to make an estimate of the arsenic contained in his own urine and fæces during twenty-four hours, or to collect the same and forward them to me that I may do so, but as yet have received no answer."—*Pharmaceutical Journal.*

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Products in the Museum, by Ed. Lankester, *M.D. F.R.S.*

Lecture IV. (May 1, 1860.) *On Bone.*

Passing from the skin of animals and its appendages, I wish to draw your attention to night to those solid interior parts which we call the skeleton, and these skeletons are composed of bones, which being solid, white, and durable, are used for a variety of purposes in the arts. We find the bones which are thus used in the arts in all the classes of vertebrate animals. There are fewer used, perhaps, for the manufacture of solid articles of use from the fish than from any other class; but whenever animals have bones they have the same chemical constituents, and these chemical constituents will be employed for a variety of purposes.

If we take bones and examine them, we shall find that they are made up of a kind of cellular structure. Bones are of various kinds. There are flat and round bones. For commercial purposes this is of importance. In the interior they are softer than on the exterior. The external surface is hard, whilst the internal cancellated structure, as it is called, is soft, but, whether hard or soft, we get the same general structure.

Now if we take a bone and look at its surface we shall find that there are a number of rather large holes, and if you make a section of it you will meet those holes which lead to canals, called Haversian canals, from M. Havers, who was the first to describe them. These vary much in size. They are smaller in the harder parts of bone and larger in the softer parts, but whether large or small they are always surrounded with a series of lamellæ, which are made up of a number of little bodies, which are called by the anatomists sometimes lacunæ and sometimes corpuscles, thus showing the difficulty of making up their minds whether they were solid. I think the universal conviction now is that they are hollow. From each side of them we have little canals opening out into the substances of the bones; *canaliculi* is their Latin name; they communicate one with the other. Now between these little cells we have everywhere a common structure, composed of four-sided bodies surrounding that canal. Now these little bodies are particles of phosphate of lime which constitute the brickwork, as it were the walls of these curiously shaped cells. The bones are finished off with two structures, which are not immediately osseous. There is a membrane covering them which is a fibrous membrane, and in the interior there is what we call marrow, and we find that the fact of the bones being hollow is of considerable utility in their manufacture. The little cells of which I have spoken, curiously enough differ in size in almost every species of animal, so that a person well informed with regard to the structure of bone may easily tell by the aid of the microscope whether a minute section, hardly perceptible to the naked eye, belong to a man, to an animal, to a bird, or to a fish. We are indebted to Pro-

[1] The fact of the preservation of the bodies shows that some considerable quantity must be retained.

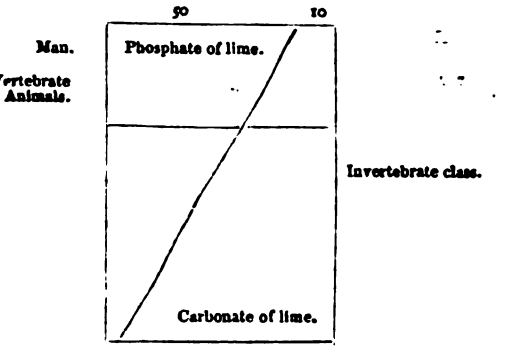
fessor Quekett of the College of Surgeons for having pointed out a remarkable fact with regard to the bone cells, and that is that they correspond in size with the size of the blood globules. You know that animals contain a quantity of cells called blood cells, which vary in size in different animals. In the human being the globules are the 3500th part of an inch in diameter, and the bone cells are the 2000th of an inch. In birds the bone cells are about the 5000th of an inch in diameter, whilst the blood globules are the 6000th. In reptiles the globules are not more than the 700,000th of an inch in diameter, and the bone cells not more than the 500,000th. There is then a general correspondence between these two bodies, but there are numerous exceptions, and the law does not hold in all cases.

Having said thus much with regard to the microscopical structure of bone, let me call your attention to its chemical composition. I have noted this down in the syllabus in order that you might carry these figures away, and it becomes frequently a matter of great interest to recollect figures. Now I have put down the composition very generally. It is not exactly the composition of human bones, or horses bones, or ox bones, but it approaches very nearly the composition of any of them. You will find that the gelatine and fat, that is to say, the parts which compose the bulk of its tissue and that which constitutes the marrow, are about 40 parts of 100, while the substance known as phosphate of lime amounts to 50 parts; then we have carbonate of lime, the common chalk, in the proportion of 8 per cent.; and then we have a little Derbyshire spar, or fluoride of calcium 1 per cent.—why it is there we do not know, but there it is, and it is very generally present in the higher animals. Then there are sulphates, magnesian salts, and so on, about one part in 100.

I go on to point out the properties of these constituents, because the properties of these substances are the properties which render the bone so valuable in the arts.

And, first, with regard to gelatine. I will not further describe gelatine this evening than just remind you that it is that material of which I spoke at first as distinguishing the animal from the vegetable kingdom, which we find constituting the great bulk of the skin of animals, and which, when placed in contact with tannic acid, forms an insoluble substance, and which lies at the foundation of our great leather manufactory. As that substance which, when boiled out of calves head and calves feet forms jellies, and which when obtained from the clippings of bones and hides makes size and glue. I need not describe it further, for we see how vastly important a substance this is.

Of the fat next I will only say that it constitutes in bone an important substance. We shall find by and by that it is a bad economy to throw bones away, that there are persons in London willing and anxious to purchase those bones, not so much for the phosphate of lime as for the fat obtained from them, which is applied in making candles and soap. Now the fat exists in the marrow, and very generally throughout the structure of the bone. The phosphate of lime has for one of its principal constituents phosphorus, which is so inflammable that we have to keep it in water to prevent it from taking fire. This combined with a large quantity of oxygen gas forms an acid called phosphoric acid, which is combined with lime to constitute phosphate of lime. The first source of this phosphate of lime as it comes into this bone is in the rocks which lie at the very foundation of the earth. First it is dissolved by carbonic acid gas in water, then picked up by the delicate blades of plants, then introduced into the stomachs of animals, then deposited in their bones, then thrown out by them and carefully collected by man and thrown on to his fields with so much diligence where he grows his cereals. It is from these last we obtain the phosphate of lime which is contained in our bones. The carbonate of lime is not an uninteresting constituent. We can generally get evidence of its existence by pouring upon a crushed bone some sulphuric acid, which produces an effervescence. Eight parts in 100 of our bones are carbonate of lime; and it is well here to speak of the relation between carbonate and phosphate of lime in forming the skeletons of so large a number of animals. In corals we have principally carbonate of lime; but as we pass up to insects and to crabs and lobsters we find a little phosphate of lime coming in, and as we go higher the phosphate of lime increases, and the carbonate of lime decreases until we come to man, who possesses the largest amount of phosphate of lime. The carbonate, however, has not been wholly dispossessed. It may be represented by this diagram —



You see here for man we put 50 of phosphate of lime and 10 of carbonate of lime, and then the phosphate of lime goes on decreasing as the animal goes lower in the scale, until at last we find scarcely any phosphate, but large quantities of carbonate of lime. Fluoride of lime is interesting as occurring in the human bones as well as the bones of the lower animals, and there is a very curious fact in connection with its presence, and that is, that a large number of the elephant tusks that have recently been brought from the Himalayas are found to contain, not phosphate of lime or carbonate of lime, but fluoride of calcium, and it is supposed by some that animals really did form their bones of fluoride of calcium, while others suppose that the bones while remaining in the earth change from phosphate of lime to fluoride of calcium. Now I will here call your attention to what we shall find of ultimate service, that carbonates of lime are in themselves insoluble in water, but if water falls down to the earth charged with carbonic acid gas, as it does when passing through our atmosphere, that water has the power of dissolving the carbonate and also the phosphate of lime. We have no other means of understanding how it is that the little plants could pick up this phosphate of lime unless it was dissolved, and it appears that phosphate of lime dissolves in water containing carbonic acid gas; and fluoride of calcium, or Derbyshire spar, dissolves in water containing carbonic acid gas, but not with equal facility. The carbonate dissolves much more freely than phosphate, and phosphate more freely than fluoride; hence it comes to pass that water passing over a substance containing phosphate of lime and also over fluoride would prefer taking up the phosphate to the fluoride, and will drop the one and take up the other. Now you see how our elephants' bones would part with the phosphate and take up the fluoride. Thus you see how we have this fluoride of calcium. In our secondary and tertiary formations we have deposits called coprolites, which are sent to the agriculturists and used for agricultural purposes. How is it then we have this deposit? Why a rain containing carbonic acid gas has percolated through these bodies and carried away the carbonate of lime and left behind this precious phosphate of lime for the increase of our civilisation and the preservation of our lives. Then besides this phosphate and carbonate of lime and this fluoride of calcium, we have certain salts which are worth mentioning as substances relating to the use of bone. There is magnesia, which must be there, and woe be to the man whose bones cannot contain magnesia. But we may leave these and look now to the uses to which these remarkable substances are applied. In the

first Lecture I mentioned to you that we might make a class of those things which were applied to the production of solid articles of use, and you see if you look around that all solid substances are applied to some purpose. We find shells forming the handles of knives, and bones and ivory used for the same purpose. Now there are a great number of uses of this kind to which bone is applied. We have a very useful application of bone in the production of buttons. Those buttons are turned in prodigious quantities in the towns of Birmingham and Sheffield, and they are sent out into the world in thousands almost from year to year. They are so cheap that some of them are sold at the rate of twelve dozen for twopence wholesale. Recollecting these facts you will come to appreciate the importance of bone in considering how valuable these little materials are to man in covering himself from the scorching rays of the sun or the inclemency of the weather. Then there are carvings of bone and ivory, such as combs, brushes, parasol handles, book openers, and so on, too numerous to mention. We do not throw away even the sawdust and bone raspings. All these are collected together and sold for various purposes in the arts. One purchases the bone dust and shavings for the purpose of manufacturing size. Another buys the bone dust for a supposed nutritious article of diet, and thus we find the roughest parts are employed. The refuse of the button-makers is gathered up and sent off to the glue-makers and manure manufacturers, and not a particle is lost. After the gelatine has been boiled out the phosphate of lime is left, and from this phosphate of lime phosphorus is procured. The chemist, by means of phosphorus, illustrates a variety of processes. He can show you the composition of the atmosphere and the nature of combustion, and a variety of other effects which he could not by any other agent. In the present day it is obtained principally for the use of the lucifer match-manufacturer. Many of you can recollect how our grandfathers and grandmothers after much labour and patience obtained a light by means of a match with sulphur. What a blowing there was, and what tears were often shed before a fire was lighted of a morning, and frequently of an evening before a candle could be seen on the table; but now all this has gone by. I can remember, when I was a lad, standing in the market place of my native town seeing a man come down the steps with a box full of little boxes of matches, which we all thought wonderful. He said we might not use them because the magistrates considered them dangerous; he rubbed them with a little phosphorus and thus procured a light. The magistrates forbade the man to sell them, at any rate at that time, as it was just when some evil disposed persons were signing themselves "Swing." The lucifer match-maker combines the phosphorus with one or two substances, either chlorate of potash or nitrate of potash. The quiet lucifer matches and foreign are made with *nitrate of potash*. The nitrate of potash in giving up its oxygen to burn does not make much fuss about it, but the chlorate of potash makes a deal of demonstration and noise.

Now there are two kinds of phosphorus, and one of which does not require to be kept in water. It is called red or allotropic phosphorus, and was discovered by Schrötter. Now the manufacture of these matches is attended with a dreadful drawback to the persons engaged. Whilst heating the phosphorus a certain quantity of the fumes escape into the air. They are taken into the system, and although the action is imperfectly understood, yet there can be no doubt that the agency of the phosphorus is to act upon the bone and to render it less capable of supporting the solid parts, and those bones die of disease. It was hoped that a remedy had been found for this, but I understand that the red phosphorus is not sufficiently inflammable, and is very little employed in the present day.

Passing on from the manufacture of phosphorus and lucifer matches, I just call your attention to the marrow and fat in the bones. I shall, more particularly in the next Lecture, have to speak of the action of these fatty matters, first, upon alkalies producing those useful substances called soaps, and then producing those candles made with fatty acids, so that I need not say anything more now.

Then passing on from these, I would just say that when one of these bones is boiled and has yielded up its gelatine and its fat, it contains still enough animal matter to render it a very useful material in the formation of animal charcoal. It was the practice formerly to take the bones to boil away the gelatine and their fat, and then send them on to the manure manufacturer, in order to be distributed over the soil; but the bones always underwent a variety of states of decomposition. In the first place if you take and expose a bone for a few days the gelatine is decomposed, and a disagreeable ammoniacal gas is formed, and some persons would hardly be satisfied with calling it an ammoniacal, but they would call it a demoniacal odour. This was one of the inconveniences or nuisances of our bone boileries; but recently these bones, instead of being sent away by cartload and shipload to various parts of the world, are converted into what is called animal charcoal. Bone charcoal must always contain large quantities of phosphate of lime. At first sight one would have thought that the presence of phosphate of lime would have been a drawback, but it has been found that it is not so. For almost every purpose for which animal charcoal is used, it is found that that from bones is by far the most effective; and we find that a large consumption of the waste bone from the bone boileries is now used by sugar refiners, and I understand that at the present moment the quantity of bones burnt in this way after the glue and size and fat has been obtained from them is astonishing, and those bones are now fetching as much as 16*l.* or 17*l.* per ton in the market.

Now I will draw your attention to their use in a most important relation, and one which has led to some of those results which can hardly be appreciated or estimated by mere figures, but must be estimated in the rise of manufactures, in the increase of happy families, and the increase of food in our country. Phosphate of lime is necessary to our bones. It is therefore necessary that we should eat food containing phosphate of lime. If we do not get this phosphate of lime our bones soften, we become a mere gelatinous mass and perish. We must, therefore, have food containing phosphate of lime. We can get this food from the animal kingdom. Beef and mutton contain phosphate of lime. But if these creatures contain phosphate of lime where are they to get it? From the grass and corn of the field. And we also must not depend upon the animal kingdom. We must obtain it from our vegetable kingdom in our wheat and our bread. We know the farmer grows a rotation of crops, and every now and then he renews the fertility of the soil, because the plant exhausts the soil of the phosphate of lime. Therefore, wherever there is phosphate of lime to be found, either in the refuse of bone manufacture, or any other place, it becomes valuable as manure. Instead of the old substances, the farmer now uses crushed bones to a considerable extent. We have now mineral sources of this phosphate of lime. We get from Sweden and other places large quantities of a mineral called apatite, and in Spain there is more.

Then there are the coprolites found on the coast of Essex, at Harwich in Suffolk, and other parts. They have been formed out of the gigantic cetaceans and sharks which are found in the London clay, and they have yielded up those coprolites which constituted their skeletons; so that we find in the bodies of the ichthyosaurus, the plesiosaurus, and others of the Saurian tribes, the iguanodon, the mastodon, the megatherium, and other gigantic extinct animals, and in the present day we manure our fields by scattering far and wide this phosphate of lime. So that you see the formation of bone is of the utmost importance to the life of man, and has led to discoveries of the utmost importance.

The phosphate of lime is not however employed merely in the form of a powder, but it is reduced to the condition of a superphosphate. It is made in the simplest way. These coprolites or the apatite is ground down, and then treated with sulphuric acid enough to take away one portion of the

phosphoric acid. By taking away a part of the lime with the sulphuric acid, we leave biphosphate in the form in which plants take it. So much, then, for the form in which the phosphate is applied to the earth. I might have said a little with regard to the production of other salts, ammoniacal salts for instance, from bones. Ammonia, consisting as it does of nitrogen and hydrogen, is got out of gelatine or any decomposing animal matter.

Now I must draw your attention for the next few moments to the nature of ivory. Ivory is a substance very much like the bone, but having a finer texture: it is more delicate in its appearance, and it has the power of enduring longer, and therefore of recompensing the labour of the artist and commanding a higher price in the market; so that you see ivory is used much more extensively for works of art. It has been a favourite material through almost all time for carving. We find among the Chinese fine carvings. These people seem to think no labour sufficient to produce these curiously carved articles. Those ivory balls carved one inside another from one piece of ivory, are marvels of patience, industry, and ingenuity. And you see what elaborate ornamentation has been put upon ordinary things — chess-men, dice, boxes, brushes, and the variety of other things of this kind.

Now let me call your attention to this ivory and speak of the structure of teeth generally, and perhaps I may be allowed to call your attention to human teeth in illustration. A human tooth consists of three parts — the outside part or enamel, the inside part or the dentine, and the part which covers the fangs, and which is called the cementum. In the interior is the substance which is called the pulp.

The teeth are connected in all animals with the jaw. They sink down into the bone; and we distinguish the teeth of the mammalia more especially from those of the lower creatures, by the fact of their sinking down into the sockets of the jaw, and are then called neural teeth, in contrast to the teeth of fish, which are called terminal teeth, growing upon the mucous membrane.

The chemical composition of the teeth is very like the chemical composition of bones, but I would just draw your attention to the curious fact that the enamel contains a very large, a much greater quantity of *solid matter* than the dentine or cementum. The enamel only contains 4 per cent. of organic matter, against 40 per cent. in the bones, and 39 in the dentine, and 30 in the cementum. I will also point out a very curious circumstance in the history of teeth, and that is that the enamel contains a certain quantity of silica, of the substance of flint, and in about 100 grains we find this hard substance giving more durability. A certain disaster is the want of silica in the teeth. Then you see the teeth wearing away, and the dentine peeping through, and ultimately the loss of the teeth. Thanks to the art of the dentist we can readily get teeth, and really seeing all the trouble we have with our natural teeth, it would seem almost desirable to get rid of the natural and take to the artificial teeth. Now it is not all teeth that are of use to the dentist, and I will just draw your attention to a few of the teeth that are employed.

Those teeth to which we more particularly give the name of ivory, are the tusks of the elephant, and the tusks of the elephant are so constructed that the whole of the outside of the teeth consists of dentine, or that matter which we find in the interior of the teeth, and which is between the cementum and the enamel in its solidity and its composition. It is on that account that we find that it is so useful in the arts; but it is not the ivory of all animals that can be employed. We have in the tusks of the walrus, the narwal, and other animals, a substance closely resembling the ivory of the elephant, which serves for the dentist, although they have not the same value as ivory.

Now the only elephants from which we derive any large or considerable quantity of ivory, are the Asiatic and African elephants, the only two alive at the present day. I may just say that the African yields tusks of greater value than the Asiatic. They are the canine teeth of these animals, and it is the male alone that yields these tusks. We obtain from the mastodon, which we find in our beds of clay, a certain quantity of ivory, and from the markets of Europe are constantly arriving ivory from those extinct animals. The tusks of the hippopotamus and the narwal and the cachalot have been employed extensively in the arts, but they have been extremely depreciated in value, for the dentist has found a substitute in vulcanised india-rubber, and this vulcanised base is found to be so much more valuable than either gold or bone, and not only do we find that bone is so little used for the manufacture of the roof of the mouth, but even for the teeth itself, as the substance is found to wear with greater accuracy, and with little decomposition. Therefore the large sale that once took place of the bones of the hippopotamus and walrus and cachalots has decreased. 50,000 of elephants' tusks, weighing 10,000 cwt., are imported every year, consequently no less a herd than 25,000 of these magnificent male animals must die every year to supply the English market alone.

You see in this, as in numerous other instances, how much man is indebted to the animal world.

PHARMACEUTICAL SOCIETY.

The Annual Conversazione of the Pharmaceutical Society was held on Tuesday evening last. The company was very numerous, and included most of the distinguished physicians and chemists of the day. A variety of interesting objects were distributed about the rooms. Among those which attracted particular attention we noticed some beautiful specimens of enamel photographs, a working model of a new pump, by Mr. Appold, Captain Chiosso's Patent Polymachinon, one of Goodchild's Trocheidoscopes, a valuable case of platinum vessels, and some aluminium caustic holders, by Messrs. Johnson and Matthey, and some specimens of Mr. Perkin's aniline dyes. Messrs. Geo. Knight and Sons exhibited a new form of Chromatrope or Colour top, the motive power being given by electro-magnetism; Messrs. Savory and Sons exhibited some of their Patent Poison Bottles, and Mr. Brewer an extensive dried collection of New Zealand Ferns.

CORRESPONDENCE.

Proposed Amendment of the Criminal Law so far as regards Scientific Evidence in Cases of Poisoning.

To the Editor of the Chemical News.

Sir,—I think most people have been struck with the defect in our system of jurisprudence which allows of chemists and other scientific men being ranged on different sides, and being placed in the position of advocates or partisans — persons who are paid to make the worse appear the better "cause," rather than as the stern enunciators of the truth, as they have discovered it by scientific means. Instances too numerous to mention at once recur to my mind, as they will to that of most who have been engaged in chemical pursuits for the last twenty years. There is no occasion to search very far back into one's experience. The Palmer case, the Torburnhill mineral case, the Smethurst case; these are instances in which scientific men have been led to exhibit science to the world as utterly unworthy of reliance in such cases. The public had been taught to believe that in judicial investigations, the chemist and the microscopist would be able to place the truth before the court in such a manner as to secure justice, and it was a terrible blow to find that the professors were at variance among themselves as to the truth. Their opinions (as *expressed* on oath) were dependent on the side for which they were engaged, and not unfrequently matters about which neither of the contending parties had perhaps in their hearts the least particle of doubt, have formed the subject of grave discussion and difference of opinion before the world.

Perhaps it would scarcely be fair to blame men of science

for this. The chief fault lies with the legislature, and it is with the view of calling attention to this, as well as of propounding what I think would be an improvement, that I trespass on your readers' attention. In cases of poisoning I am inclined to think that it would be better that the examination should be ordered by the coroner or magistrate, and that the stomach and its contents, and other portions of the body, should be entrusted for examination to one, two, or three chemists, either separately or in conjunction, by a judge of one of the superior courts, before whem the chemist or chemists should first be sworn. These *experts* should each, separately or altogether (as may be deemed best by the legislature) deliver written reports to the judge before the trial, which shall be read in court as their evidence, and they shall be liable to cross-examination on the part of prosecution and defence. I believe this system, or something akin to it, is in force in France. The benefits I anticipate from its adoption in our criminal procedure are these:—The chemist will be free from the bias of either prosecution or defence, being simply engaged by the court, and he will, as I imagine, be indifferent as to "which side wins." He will no longer be an advocate or a partisan; the jury will have no reason to suppose that he has endeavoured for pay to prove the existence of poison when absent, or *vice versâ*. At present, it must be confessed, neither the judge, the jury, nor the public, have any confidence in the scientific evidence in cases of poisoning. This want of confidence is extremely detrimental to the public, to whom the administration of justice is of the highest importance.

I am not able at present to do more than offer my suggestion to the legislature, the profession, and the public, and I hope that in an early session of Parliament some measure will be brought forward with the view of amending our procedure in cases of criminal poisoning, besides affording opportunity of appeal in certain cases, and under the requisite conditions and restrictions. I shall be happy to see the subject discussed in your columns, and hope eventually that my plan will be adopted, with such additions and modifications as may be found necessary.—I am, &c.

J. W.

Shade for Parabolic Reflectors.

To the Editor of the Chemical News.

Sir,—I was reminded by Professor Faraday's Lecture on Lighthouses, that I had proposed in the *Mechanic's Magazine* for June 1858 a shade for parabolic reflectors. The idea was to place a reflector in front of the flame, large enough to throw back all that light which does not fall upon the parabolic reflector, and which therefore is lost. I apprehend that the reflector should be circular, or some shape closely approximating to this. It should, as a little consideration will show, be proportionately small; and I think that the benefit gained by the increased amount of light thrown into the cylindrical beam, would more than compensate for that of necessity directly excluded. The requisite size to produce an increase of light would of course be a question of experiment or calculation, supposing it possible that any increase could thus be obtained.—I am, &c.

J. A. Davies.

The Cause of the Relation between Specific Heat and Atomic Weight.

To the Editor of the Chemical News.

Sir,—It has been observed that the relation between the specific heat and the atomic weight of all bodies, both simple and compound, varies almost inversely, their atomic weights increasing almost in the proportion that their specific heats decrease. I apprehend that this may be explained by the following considerations.

Without confusing oneself either about the size or the quantity of atoms composing equal bulks of different substances, I think it probable that the heaviest substance contains the most matter. If all substances consist of the same matter, variously arranged and more or less compressed, this supposition is correct; but if there are various species of matter, irrespective of compression, it does not follow that the heaviest substance contains the most matter: I think, however, that the former supposition is the true one.

From it it follows, that substances are less porous as their atomic weight increases, and consequently afford less room for the vibration of the interfluent ether. Consequently the specific heat decreases as the atomic weight increases, and this because the ether cannot vibrate so freely, or produce such forcible friction. It cannot certainly be said that this would occur were the latter supposition correct; inasmuch as it has not, I think it cannot, be proved that heavy matter must contain smaller interstices than that of a less ponderous nature.—I am, &c.

J. A. Davies.

Material for Paper.

To the Editor of the Chemical News.

Sir,—In these parts a glutinous mass is obtained to feed pigs with by boiling fern when in the curl. It has struck me that it might be possible out of this mass to manufacture paper, and with a little contrivance to secure two or three crops of curl.

If this suggestion does not appear to you absurd, perhaps you will be good enough to insert it in the Chemical News.

I am, &c.

Ex-Chemicus.

Use of Offal of slaughtered Animals for producing Soap.

To the Editor of the Chemical News.

Sir,—At page 263 Chemical News, a patent for this soap is noticed. That Mr. Davies may not be exposed to expenses in this matter, I beg to inform him that such a soap is not new: I was engaged in and made it about twenty-eight years ago.—I am, &c.

George Whipple, F.C.S.

Chemical Notices from Foreign Sources.

I. Mineral Chemistry.

Soluble Silicate of Lime and Soda.—M. Bolley[1] has noticed the existence of a soluble double silicate of lime and soda. This salt is formed when a solution of silicate of soda is added to lime water. It is amorphous, transparent, and when heated, melts into a clear glass. Baryta and magnesia also form soluble salts with silicate of soda. These facts, the author remarks, are of much importance in studying the silicatisation of stones, and have no less interest in connexion with geology. They may also throw some light on the formation of the framework of vegetables.

Natural Borate of Lime.—For ten years, says the *Moniteur Scientifique*, a white salt has been imported from Chili, consisting of brilliant silky crystals agglomerated into nodules of greater or less size. According to M. Salvetat it contains 12 per cent. of boracic acid, and according to other chemists 50 per cent. The other constituents are sulphate of soda, earthy matters, and sand. This borate of lime, according to its richness, may be used directly as a flux, and M. Salvetat has substituted it for borax in glazing Sèvres ware. He has succeeded in forming a glaze of good quality by melting together one part of this rough borate of lime, 2 parts of sand, and 4 parts of minium.

Volatility of Anhydrous Phosphoric Acid.—Lautemann asserts[2] that it is more volatile than has been supposed: it may be sublimed in a glass tube over the flame of a spirit lamp.

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[1] *Répert. de Chim. pratique*, t. i. p. 31.
[2] *Annal. der Chem. und Pharm.* Bd. cxiii. s. 240

II. ORGANIC CHEMISTRY.

Transformation of Starch into Dextrine and Glucose.—M. Musculus believes[2] that the formation of dextrine and glucose is rather the result of a decomposition of the amylaceous matter than the simple assimilation of water. His reasons for supposing so are: 1. That diastase has no action on dextrine. 2. That dextrine and glucose appear simultaneously when starch is acted on by diastase, and always in the same relation, *viz.* 1 equivalent of glucose and 2 equivalents of dextrine. 3. That dilute sulphuric acid acts at first in the same way as diastase, but differs in this, that the reaction continues after all the starch has disappeared, only more slowly. If glucose be formed from dextrine by the assimilation of water, it is difficult to understand why its formation should be more rapid while some unchanged starch remains in the liquor than when only dextrine remains: the contrary ought to be the case. 4. The simultaneous appearance of dextrine and glucose takes place with sulphuric acid as well as diastase, and the proportions are the same.

The practical conclusions which the author draws from the facts are: 1. That in the manufacture of glucose, if we regard the action as finished when the liquor is no longer blued by tincture of iodine, a large quantity of dextrine remains mixed with the sugar, and as dextrine does not ferment with yeast a great loss is caused to the consumer. The manufacturers ought therefore to employ a higher temperature, and leave the acid and starch a longer time in contact. 2. The great resistance which dextrine offers to the action of dilute sulphuric acid furnishes an easy means of estimating a mixture of cane sugar and dextrine. Boiling for a minute with the acid is sufficient to modify all the cane sugar, so as to render it fit for the cupropotanic tartrate test, while the dextrine undergoes no change in the same time. If any starch were present at the same time it might be got rid of by diastase, which has no action either on the cane sugar or dextrine. 3. The action of diastase explains how it is that brewers are obliged to employ an enormous quantity of barley to obtain a beer with but little alcohol: two thirds of the starch pass into dextrine. 4. That in making spirit from malt there is an inevitable loss of two thirds.

Quadricarbide of Hydrogen.—M. Berthelot[4] announces the discovery of a third compound of carbon and hydrogen, *acetylene* or *quadricarburetted hydrogen*, represented by the formula C_4H_2, the prototype of a new series of carbides $C_{2n}H_{2n-2}$. Acetylene is produced whenever olefiant gas, the vapours of alcohol, ether, aldehyde, or even wood-spirit, is passed through a red hot tube. It is also found when the vapour of chloroform is acted on by metallic copper at a red heat: it also forms part of coal gas. Ether, however, furnishes it in the largest quantity. It is a colourless gas, somewhat soluble in water, and has a characteristic disagreeable odour; it burns with a luminous but smoky flame. Mixed with chlorine it explodes almost immediately even in diffused light, with a deposit of carbon. M. Berthelot has not succeeded in liquefying it either by cold or pressure. Its density is equal to 0·92. One volume burnt in a eudiometer formed two volumes of carbonic acid by absorbing two and a half volumes of oxygen. These results, joined with the density, determined the formula to be C_4H_2, the formula representing four volumes.

Acetylene is the least hydrogenated of the gaseous carbides of hydrogen, which accounts for its great stability. Its percentage composition is the same as that of *benzine* $C_{12}H_6$, and of *styrol* $C_{16}H_8$, but these two bodies are liquid and their vapours more condensed. Lastly, acetylene C_4H_2 only differs from *aldehyde* $C_4H_4O_2$ and from *glycol* $C_4H_6O_4$ by the elements of water. The author, however, did not succeed in forming these two bodies by reactions conducted at a low temperature. We shall return to the chemical properties of acetylene.

[2] *Comptes-Rendus*, t. l. p. 784.
[4] *Ibid.* p. 805.

III. TECHNICAL CHEMISTRY.

Tinctorial Properties of Albumen.—M. Guinet[1] has observed some new facts relative to the tinctorial properties of albumen. When a tissue printed with albumen is placed in water, the water penetrates the albumenised parts very slowly. If a liquid insoluble in water be added, and all be shaken together, the insoluble liquid will only attack the albumenised parts, and will dye them if it contains an available colouring matter: for example, a fatty oil containing alkanet in solution, or rough aniline, which turns albumen brown.

Neutral chromate of potash will not dye albumen, but the bichromate or a dilute solution of chromic acid colours it yellow. Albumen thus dyed takes a bright lemon yellow in a solution of acetate of lead, a red in a sufficiently concentrated solution of nitrate of silver, and becomes black in a logwood bath.

Permanganate of potash colours albumen brown without dyeing the non-albumenised parts. M. Terreil employs the permanganate to dye wool and silk a dark maroon.

By boiling in a solution of a salt of peroxide of iron albumen is coloured a pale brownish yellow, and so prepared will take a blue colour with ferrocyanide of potassium, a violet with a decoction of garancine, and a black with logwood.

Ammoniacal sulphate of copper colours albumen blue, which by the action of alkalies (lime-water, for instance) is changed to a bright lilac violet; with the ferrocyanide of potassium the red maroon colour of the ferrocyanide of copper is obtained.

An ammoniacal solution of cobalt also tints albumen.

The salts of gold, platinum, and palladium, colour albumen yellow without attacking the non-albumenised parts of the tissue. When coloured with gold it is changed to a deep violet, almost black with protochloride of tin or sulphate of the protoxide of iron, and when coloured with platinum it becomes a bright yellowish brown with protochloride of tin.

SCIENTIFIC NOTES AND QUERIES.

Quantitative Estimation of Mixtures of Potash and Soda.—Sir,—In Parnell's *Chemical Analysis*, page 304, in treating on the separation of soda from potash, he states 1 part of neutral sulphate of potash produces 1·31818 of sulphate of barytes, and 1 part of neutral sulphate of soda produces 1·61111 of sulphate of barytes. The number of grains of the material used is multiplied by 1·318, the product subtracted from the number of grains of sulphate of barytes obtained by experiment. The remainder divided by ·29293 gives the quantity of sulphate of soda. Again, in the chloride, 1 part of chloride of potassium produces 1·894 parts of chloride of silver, and 1 part of chloride of soda produces 2·400 parts of chloride of silver. The number of grains used of the dry chlorides is multiplied by 1·894, the product subtracted from the number of grains of chloride of silver obtained by experiment, and the remainder divided by 0·506.

Will you oblige by making the subject plain by stating where he gets the first number ·29293 in the barytes test, and also the 0·506 in the chloride silver test.—*A Student.*

[The number ·29293 is the difference between 1·61111 and 1·31818; and the number ·506 is the difference between 2·400 and 1·894.—Ed.]

LABORATORY MEMORANDA.

Detection of Chromium by means of Peroxide of Lead.—Sir,—I read with great interest the account of the various methods for the detection of small quantities of sesquioxide of chromium in presence of sesquioxide of iron in your last. That of oxidising by means of peroxide of lead is given in the *Tables to accompany Conington's Handbook of Analysis*, and was employed by myself and others, recent students in a London laboratory, several times with great success. But on one occasion we all returned "chromium" as one of the ingredients in a solu-

[1] *Répert. de Chim.* Avril 1860.

tion given us for examination, and were as sure of its presence as the professor was of its absence. The mystery was quickly solved by boiling a little of the suppose *pure* peroxide of lead (with which reagent we were furnished from one common supply) with caustic potash alone, and acidulating the filtrate with acetic acid, a precipitate having all the properties of chromate of lead was thrown down. We then tried various samples of binoxide of lead, and found some to be free from, others to be contaminated with, chromium.—*C. W.*

MISCELLANEOUS.

Carbonate of Lead from Coffins.—Mr. R. V. Tuson has examined some pieces of decayed leaden coffins, which had lain in a vault, it is believed, for eighty years. The pieces were about a quarter of an inch in thickness; they had a laminated structure, and possessed a fawnish or drab-white colour. Neither crystalline form nor metallic lead were detected, even by the aid of the microscope. The material was tolerably brittle, and readily reduced to an impalpable powder. On submitting it to quantitative analysis, the following were the results obtained:—

Moisture . . .	0·10		
Organic matter and loss	0·52		
Peroxide of iron . .	1·94		
Protoxide of lead . .	82·29	= {PbO, CO^2	92·28
Carbonic acid . .	15·15	+ PbO	5·16
	100·00		

These results show that it chiefly consists of protocarbonate of lead with a small proportion of anhydrous protoxide. The production of these compounds was doubtless mainly due to the moisture and carbonic acid evolved during the decay of the animal remains, acting conjointly with the oxygen of the air. If one might venture to assign a formula to this mixture of carbonate and oxide of lead, its composition would be represented by PbO + 15 (PbO, CO^2), as the following numbers clearly indicate:—

	Calculation.	Experiment.
16PbO = 1785·6 . .	84·41	84·45
15CO^2 = 330·0 . .	15·59	15·55
	100·00	100·00

The interesting points in connexion with this substance are, that it is anhydrous, that it contains but a small excess of oxide, and that it consequently differs in composition from any of the carbonates of lead hitherto described as being produced by the united action of air and water on metallic lead; or by the influences concerned in the well known Dutch method for manufacturing "white lead." The difference in composition of the various carbonates of lead formed under the circumstances referred to, will be seen by glancing at the subjoined table:—

Source.	Composition.
Air and water on lead .	PbO, HO + PbO, CO^2.
Dutch method . . .	PbO, HO + 2(PbO, CO^2), and sometimes PbO, HO + 3(PbO, CO^2).
Leaden coffins . . .	PbO + 15(PbO, CO^2).

Were any of these hydrated and basic carbonates of lead exposed sufficiently long to the action of carbonic acid, they would in all probability be transformed into perfectly neutral and anhydrous carbonates. It is most likely that the lead of the coffins was first converted into hydrated oxide, then into hydrated and basic carbonate, and finally into the anhydrous carbonate of the composition already given.—*Phil. Mag.*

Adulteration in America.—A chemist in Quebec has recently published the result of a chemical analysis of some of the articles of consumption sent to that city by New Yorkers. He found in pickles, which bear the label "no sulphate of copper," not this salt, but sulphate of iron instead. In sherry wine he discovered an immense quantity of salt. In the green tea he found copperas. The gin was nothing but whiskey and essence of juniper. In snuff he found peroxide of iron and other chemicals to the extent of one-fifth of its bulk.

Removing Silver from Injured Plated Ware.—Among the many branches of manufacturing at Nuremberg in Germany, that of metals into various articles has attained considerable importance. They include silver-plated ware of different styles and quality, which necessarily produce large quantities of spoiled materials and clippings, the recovery of which has hitherto been very imperfectly accomplished, thus causing annually a considerable loss. The reason of it was, the want of a method by which the silver might be removed without much expense, and the copper thus freed from its coating used again.

Repeated experiments have led to a very simple process by the action of concentrated nitric acid on silver and copper when present together. If these metals are placed into common commercial acid (sp. gr. 1·47) they will both be strongly acted on, but a separation of the two is unattainable, since the copper, so long as any remains undissolved, will precipitate the silver from its solution, by galvanic action. Nitric acid of the highest specific gravity (1·5), however, acts on the silver but not on the copper; it renders the copper more electro-negative than before, less oxydisable, and deprives it of the property of decomposing the acid, and precipitating the silver.

To produce this passive condition of copper, it is not absolutely necessary to employ directly acid of that specific gravity; for any concentrated nitric acid can be made to answer the purpose by the addition of a sufficient quantity of the oil of vitriol, which deprives it of a portion of its water, and thus contributes to make it stronger. A mixture of one volume of nitric acid (sp. gr. 1·47) and six of vitriol does not dissolve copper at the temperature of boiling water, but with a smaller proportion of sulphuric acid, evolution of nitrous oxide takes place. The same end, and much cheaper, is obtained by employing a mixture of oil of vitriol and nitrate of soda, which are the materials used in the practice. The following is the method now generally employed:—Oil of vitriol, together with 5 per cent. of nitrate of soda, is heated in a cast-iron boiler, or better, a stoneware pan, to 212° Fah. The silver-plated clippings are placed in a sheet-iron bucket or colander, which is fastened to a pulley that it may be moved about in the acid. As soon as the silver is removed, the colander is raised, allowed to drain, then immersed in cold water, and emptied to be again used in the same manner. When the acid bath is fresh, the desilvering proceeds very rapidly, and even with heavy plated ware takes but a few minutes; with the gradual saturation of the bath more time is required, and it is readily perceived when the acid must be renewed. The small amount of acid solution adhering to the copper precipitates its silver when brought into the water. To obtain its complete removal, the clippings, when raised from the de-silvering bath, and before immersion in water, may be dipped into a second bath prepared in the same manner, which is afterwards to be used in place of the first.

The saturated bath, on cooling, congeals to a crystalline semi-fluid mass of sulphate of copper and of soda. The silver is removed by chloride of sodium, which is added in small portions at a time, while the solution is yet warm. The chloride of silver separates readily, and is washed and reduced in the usual manner. The acid solution contains but a very small portion of copper, hardly enough to pay for recovering.—*Drug. Circular.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

L. G.—It is no test for soda, merely a test for soluble alkali. A test for soda is of no use if potash produces the same effect.

J. C. K.—The reference ought to have been *Répertoire de Chimie*, April.

A Subscriber.—1. We do not know where Deville's furnaces can be bought. Apply to Messrs. Johnson and Matthey, Hatton Garden. 2. *Galloway's Chemical Analysis*, Churchill 4*s*.

A. R. William.—1. You will find them in Cooley's *Cyclopædia of Practical Receipts*, 3rd. edition, and in Parrish's *Manual of Pharmacy*. 2. The composition of the liquid is described in the specification of the patent, which you can read at the Patent Office, or purchase for 3*d*.

A Student.—Fresenius' *Quantitative Analysis*, edited by Bullock, 15*s*. or Rose's translated by Dr. Normandy.

J. Ogston.—The material wants strength, and its use would altogether depend upon the price. Send a specimen of the stouter kind with the prices of both.

Vol. I. of the Chemical News will be completed with No. 26. Handsome cloth cases, gold lettered, for binding the volumes have been prepared, price 1*s*. 6*d*. Subscribers may have their copies bound for 2*s*. If sent to our office, or, if accompanied by a cloth case, for 6*d*.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On an apparent Perturbation of the Law of Definite Proportions observed in the Compounds of Zinc and Antimony, by JOSIAH P. COOKE, *Jun. Cambridge, U.S.*

IN a former paper[1] I described two new compounds of zinc and antimony $Sb\,Zn_3$ and $Sb\,Zn_4$ which I named respectively Stibiotrizincyle and Stibiobizincyle, because they resemble in their composition the metallic radicals of organic chemistry, and because the first decomposes water rapidly at 100° C. I there stated that crystals of $Sb\,Zn_3$ could be obtained containing a much larger amount of zinc than that required by the law of definite proportions, and that this change was not accompanied by any alteration of crystalline form. A similar variation of composition was afterwards observed in the crystals of $Sb\,Zn_2$, and it is now my object to describe the law of the variation and to explain its cause.

In the course of my investigations on this subject, crystallisations were made or attempted of alloys differing in composition by one half to five p. c. according to circumstances, from the alloy containing 95 p. c. of zinc to that containing 95 p. c. of antimony; but only two crystalline forms were observed, that of $Sb\,Zn_3$ and that of $Sb\,Zn_2$. Well defined crystals, like those described under $Sb\,Zn_2$ in the former paper[2], were obtained from the alloys between 43 and 60 p. c. of zinc; and even in alloys of a higher zinc percentage crystals of the same form were still seen, although they were no longer well defined. In the alloys between 20 and 33 p. c. of zinc, well defined crystals, like those described under $Sb\,Zn_2$ in the same paper, were formed; and finally there separated from the alloys between 33 and 42 p. c. of zinc thin metallic plates, which evidently belonged to the same crystalline form. In making the alloys from 43 to 95 p. c. of zinc, the zinc was melted first, and when in fusion the antimony was added. As the melting point of antimony is much above that of zinc, the fluid zinc acted on the solid antimony as a solvent, dissolving the pure metal but not the impurities, which rose to the surface forming a scum. This scum seemed to take with it some of the antimony, and thus caused a loss, which, together with the impurity, was found by experiment to be about three p. c. of the antimony used. This resulted in raising the percentage of zinc in the alloy at most about eight-tenths of one p. c. The alloys below 43 p. c. of zinc were made by melting the antimony first, and then adding zinc. By this method the loss of antimony was very greatly diminished, and, counting the impurity, was found to be only about one per cent. and a half of the antimony used. In preparing the alloys this loss was always allowed for, and the crystallisations were all made as nearly as possible under the same circumstances, so that any unexpected cause of error should affect all equally. The crystals formed in the alloys were all analysed in my laboratory, under my direction and immediate supervision, and the greater part of them by myself:—

ANALYSES OF THE CRYSTALS FORMED IN THE ALLOYS OF ZINC AND ANTIMONY.

STIBIOTRIZINCYLE.					STIBIOBIZINCYLE.				
Composition of the Alloys by Synthesis.		Composition of the Crystals by Analysis.			Composition of the Alloys by Synthesis		Compos tion of the Crystals by Analysis.		
Per cent. of Zn	Per cent. of Sb.	Per cent. of Zn	Per cent. of Sb.	Sum.	Per cent. of Zn	Per cent. of Sb	Per cent. of Zn.	Per cent. of Sb.	Sum.
70·40	29 60	64·15	35·77	99·92	33·00	67·00	35·37	64 57	99·94
66·50	33 50	61 00	39 00	[3]100 00	do.	do.	35·40	64 60	[4]100 00
64·50	35·50	53·50	41·44	94·94	32·50	67·50	34 62	64·92	99 54
. .	. .	55 49	44 42	99·91	do.	do	34·61	65 39	[4]100 00
60·60	39 40	55 00	45·09	100.09	31·50	68·50	33·95	66·09	100 04
58 60	41 40	50·39	49.29	99 61	29 50	70·50	33 62	66 38	[4]100 00
56 60	43·40	49 92	50 05	99 77	do.	do.	33 62	66·38	[4]100 00
54 70	45 30	48 26	51·42	99 68	27 50	72·50	33 85	65 81	99 66
52 70	47 30	47·47	52·53	[4]100·00	26·50	73 50	32 08	67 60	99·68
. .	. .	. .	. .	. .	26 00	74·00	30 74	69 06	99·80
50 70	49.30	46 89	53·11	[4]100·00	25·50	74 50	10 43	69·51	99 94
do.	do.	46·45	53·55	[4]100 00	25 00	75·00	29 88	70 20	100 08
48 70	54 30	48 66	51·34	[4]100·00	24·50	75 50	28 76	71 24	100 00
46·70	53·30	46 77	53 23	[4]100·00	23·50	76·50	27·91	71.85	99 78
44·80	55·20	44·26	55 73	[4]100 00	22·50	77·50	26 62	73·27	99 89
43 80	56 20	44 04	55 96	[4]100·00	21 50	78·50	24·83	74 74	99 57
42 80	58·20	43·15	56 93	100·08	20·12	79·88	20·58	79 42	100 00
do.	do.	43·00	56·50	99 56					
do	do.	42·83	57 24	100 07					

It has already been stated that the crystals of $Sb\,Zn_2$ are obtained in their greatest perfection from the alloy of 42·8 p. c. of zinc. They are then comparatively large, generally aggregated, and, as the three analyses cited in the former paper prove, have the same composition as the alloy. On increasing gradually the amount of zinc in the alloy up to 48·7, the crystals continued to have the composition of the alloy, and the only difference which could be observed in their character was that they were smaller and more frequently isolated. Between these limits the whole mass of the alloy exhibited a strong tendency to crystallise, and by pouring it as it cooled, from one vessel to another, it could be crystallised to the last drop. On increasing the amount of zinc in the alloy to 50·7 p. c. the amount of zinc found in the crystals was only 46·89 p. c. and above this it was uniformly less than it was in the alloy; but no closer relation between the two could be detected, owing undoubtedly to the unavoidable irregularity in the crystallisations of the alloys, which contained more than 50 p. c. of zinc. This arose from a peculiar pasty condition which the fluid mass assumed at the point of crystallisation, apparently caused by the separation of the excess of zinc. Definite crystals however were obtained even from the alloy of 60 p. c. of zinc, which contained 55 p. c.; above this, the crystals became less and less abundant, and gradually faded out, although the alloy even of 86 p. c. of zinc exhibited a radiated crystalline texture, and a trace of this structure could still be discovered even in the alloy containing only 4 p. c. of antimony. It might be supposed that on returning to the alloy of 42·8 p. c. of zinc, and increasing

[1] *American Journal of Science and Art*, xviii. 234.
[2] *Ibid.*

[3] In this analysis the antimony only was determined.
[4] In this analysis the zinc only was determined.

the amount of antimony, we should obtain crystals containing an excess of antimony, but so far is this from being true, that the slightest excess of antimony entirely changes the character of the crystallisation. On crystallising an alloy containing 41·8 p. c. of zinc, not a trace of any prismatic crystals could be seen, but in their place there was found a confused mass of thin metallic scales, which, as will soon be shown, are imperfect crystals of $Sb\,Zn_3$. Thus it appears that although perfectly formed crystals of $Sb\,Zn_3$ can be obtained containing 55 p. c. of zinc, they cannot be made to take up the slightest excess of antimony.

In order to obtain crystals having the composition of $Sb\,Zn_2$, that is, containing 33·5 p. c. of zinc, it is necessary to crystallise an alloy at least as low as 31·5 p. c. of zinc. At this point large compound crystals are obtained corresponding to the large crystals of $Sb\,Zn_3$. On increasing the amount of zinc in the alloy up to 33 p. c. the proportion of zinc in the crystals appeared to increase in the same ratio. The crystals of $Sb\,Zn_2$ containing an excess of zinc, are smaller and more frequently isolated than those containing exactly two equivalents. A similar fact, it will be remembered, is true of the crystals of $Sb\,Zn_3$. At the alloy of 33 p. c. of zinc, the definite crystals of $Sb\,Zn_2$ begin to disappear, and are succeeded by thin metallic scales, which, as the two following facts will prove, are imperfect crystals of the same crystalline form. First, the scales from the alloy of 33 p. c. are frequently found having a definite crystal as a nucleus, when it is evident that their surfaces are extensions of the basal plane O of fig. 2 of the former memoir. Secondly, the scales twin together like the large tabular crystals of $Sb\,Zn_3$, forming a cellular structure, and the angle between two scales thus united measured with an application goniometer approximately 115° 30′, and was therefore equal to the basal angle of the definite crystals. These scales continue up to the alloy of 41·8 p. c. of zinc, becoming however constantly less abundant and less distinct. Several specimens of them were analysed, but no regularity in their composition could be detected, except that they all contained a very much larger amount of zinc than the alloys in which they formed. This irregularity and the imperfection in the crystallisation seem to be caused by the interference of $Sb\,Zn_3$, that is, by a tendency to form $Sb\,Zn_3$, which exhibits itself in a proneness of the crystals of $Sb\,Zn_2$ to an excess of zinc. On returning to the alloy of 31·5 p. c. of zinc, and adding an excess of antimony, it was found that the crystals formed continued to have the theoretical composition of $Sb\,Zn_2$ until the amount of zinc in the alloy had fallen to 27 p. c. so that the tendency towards the theoretical composition was so great, that in the alloys between 31·5 and 27 p. c. of zinc, crystals were formed having very nearly this composition. On still further increasing the amount of antimony in the alloy, the composition of the crystals gradually approached that of the alloy, and from the alloy of 20·2 p. c. of zinc very imperfect crystals were obtained, having almost the same composition as the menstruum. At the same time, the crystals became less and less perfect, and finally disappeared altogether in the alloys below 20 p. c. of zinc.

Before discussing the conclusions to which the facts already stated seem directly to point, it will be well to see how far the variation in composition corresponds to a variation in the properties of the two compounds. Three classes of properties have been examined in this connection, *viz.* specific gravity, crystalline form, and affinity for oxygen, which will be treated of in order.

(*To be continued.*)

TECHNICAL CHEMISTRY.

On the Action of Hypochlorite of Lime on Sulphur, and the Employment of a Mixture of these Bodies for the Vulcanisation of India-rubber, by M. Gaultier de Claubry.[1]

Mr. Parkes of Birmingham first made known the curious fact that caoutchouc in contact with very small quantities of chloride of sulphur dissolved in any convenient menstruum, sulphide of carbon, for example, became vulcanised at the ordinary temperature. This process allows of the vulcanisation of many objects on which it would be impossible to operate at a high temperature, such as very thin sheets of caoutchouc, or woollen garments, or silk fabrics dyed in colours which cannot resist a great heat. Mr. Parkes also pointed out the precautions necessary when thick pieces are operated upon; but whatever care may be taken it is easy to see that it is almost impossible to obtain in this way products equally vulcanised.

Mr. Parkes has pointed out another way by which a better effect is produced, which consists in mixing with the caoutchouc paste what he calls *dry chloride of sulphur*. This name can only be applied to flowers of sulphur impregnated with chlorine, and by means of this mixture india-rubber can really be vulcanised in the cold, and the greater part of the sulphur remain in the state of simple admixture.

The analysis of a great number of vulcanised objects having revealed the presence of chloride of calcium, it occurred to me that this salt might come from hypochlorite of lime which had been used in the caoutchouc paste to produce the chloride of sulphur necessary for vulcanisation, and that it was such a mixture which Mr. Parkes used. The following facts prove beyond doubt that it may be employed for the purpose.

If we simply shake flowers of sulphur and dry hypochlorite of lime together at the ordinary temperature, the two are scarcely in contact before a strong smell of chloride of sulphur is manifested. If the two be rubbed together in a pestle and mortar, the temperature of the mixture rises, the sulphur becomes soft, and the whole agglutinates into mass with the abundant evolution of vapours. When the sulphur is greatly in excess relatively to the hypochlorite the mixture of the two bodies should be made without rubbing; it may then be added to the caoutchouc paste with or without the addition of other substances, such as chalk, zinc white, &c. and the vulcanisation may be effected either at the ordinary temperature, or at a gentle heat. By this process it is possible to obtain india-rubber of any thickness uniformly vulcanised.

When sulphur is mixed with a large excess of the hypochlorite of lime by merely shaking the two together, the temperature quickly rises very high and strong action takes place, therefore the mixture must never be made in a close vessel.

The Society of Arts Exhibition of Inventions.

The Twelfth Annual Exhibition of Recent Inventions was opened to the public on the 9th of April, and although perhaps not quite so interesting in its general character as some of its predecessors, has yet many attractions for the capitalist, the mechanic, and the man of science,

[1] *Comptes-Rendus*, t. l. p. 976.

while Paterfamilias may derive at once pleasure and instruction from even a casual inspection.

Glancing over the first division of the catalogue, we find but few inventions or appliances within our province, but our attention is arrested for a moment by a couple of new safety lamps for mines, slightly different in principle, although similar in their general action. They both appear to possess greater security than those ordinarily employed, as the flame is instantly extinguished when any attempt is made to open them. Mr. C. H. Waring effects this object by necessitating the drawing down of an extinguisher upon the wick, before a bolt confining the gauze can be released. The "safety-bolted gun" of Mr. Atkinson, is intended to diminish the number of those melancholy accidents arising from the premature discharge of fire-arms, which are so prevalent after September 1st.

In the next department, we first notice the blast furnace of Mr. J. J. Griffin, which has already been described in these pages (Chemical News, p. 27), and near at hand are a collection of articles exhibited by the Patent Plumbago Crucible Company, which students of chemistry and metallurgy would do well to study. The apparatus of Mr. J. Henry Griesbach, for printing the vibrations of musical strings, certainly displays much ingenuity, although its practical applications may not be very numerous. In this contrivance a string is so arranged that after having been tuned to any particular note its vibrations impinge upon a slip of brass, and by means of an attached pricker and piece of "carbonic paper," print a series of dots upon a slowly-moving paper band. Time is kept by a pendulum or metronome. Professor Hughes shows this year a "dial telegraph," which has the advantage of being easily worked by any person without difficulty, as the mere pressing down of keys bearing the letters of the alphabet closes the voltaic circuit, and the distant instrument instantly imitates the transmitting "dial." The "linograph" of Mr. D. McCallum is for the purpose of recording messages on thread, with various coloured inks.

The insulating compositions and arrangements of various exhibitors deserve much attention, as also do the telegraph cables of Messrs. Hall and Wells. Mr. W. Symons's "combined maximum and minimum thermometer" seems principally to "combine" most of the disadvantages of those now used. It is on the same principle as Sixe's instrument, but the position of the fluids are just reversed, the bulb being filled with mercury, which acts upon two small indices, separated by a column of spirit: as might be expected the mercurial thread is seldom intact, the alcohol finding its way between it and the glass. The cheap polarising apparatus of Mr. Bestall is certainly effective, and will supply a want. Further on in the catalogue appears the name of Mr. Wentworth Scott, in connection with fibre specimens mounted for the microscope in a new and simple manner.

Of the illustrative specimens of "electro-block printing," an invention of much merit and utility, we need say little, as they explain themselves in a great measure. For an enlarged copy of an engraved plate or block, &c. a transfer impression is taken upon a sheet of caoutchouc prepared with an equally elastic composition, and this sheet is then stretched in a frame to the required size. When reduction is the object, the caoutchouc is extended *before* receiving the impression, and afterwards permitted to contract to the dimensions previously decided upon. Mr. Paul Pretsch wishes to employ deposits of electro-silver in place of the ordinary moulds for producing the "watermarks" in paper. Messrs. Versmann and Oppenheim exhibit specimens of their non-inflammable fabrics, and lastly in the division, we now notice the "ozonised cod-liver oil" of Mr. E. C. Allen which, in spite of "testimonials," we suspect to belong to the same respectable category as the "Methuselah Pill," "Oliver's Odonto," &c. &c.

In the agricultural department there is little of special interest to our readers, save perhaps Mr. Roberts's proposed method of applying chemical manure in small cubes, which also contain the seed, thus protecting the latter from birds, insects, &c.

In the next class Mr. Ransome heads the list with some specimens of his silicated stone, and further on an ingenious heat-indicator for ovens, &c. is observable; but our old enemies, want of space and time, now press on so hardly, that we must perforce now pass over many inventions of intrinsic value or general interest. In conclusion, we may briefly name the specimens of worked aluminum exhibited by Mr. F. W. Gerhard, the metal having been produced by the process of the above gentleman at his works at Battersea. We have never before seen the metal with so fine a tint, and of such apparent purity.

We have scarcely even indicated a tithe of the inventions it would under other circumstances be interesting to consider, but will conclude with an earnest recommendation to our readers to go and see for themselves, as they can be admitted by order from any member of the Society of Arts, and the present collection of new appliances will amply repay the trouble of inspecting them.

Aonides.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Eight Lectures, on Some Results of the Association of Heat with Chemical Force practically applied; by F. A. Abel, *Esq. Director of the Chemical Establishment of the War Department.*

Lecture I. (*April* 21, 1860.)

The lecture was devoted to an examination of the conditions favourable to the considerable development of heat by the operation of chemical force.

The Lecturer, referred, in the first instance, to the intimate relation existing between chemical force and heat, and to the general manifestation of the latter upon the development and consequent disappearance for a time of chemical action.

The fundamental principles which regulate the operation of chemical affinity were briefly reviewed. The audience was reminded that chemical attraction, like that of cohesion, requires that the particles of matter should be brought into very intimate contact in order that its influence may be fully exerted, and that the more opposed different substances are in their chemical properties the more powerful will the attraction be, which they will exhibit for each other if brought together under favourable conditions. The heat resulting from the operation of chemical attraction is proportionate to the intensity with which this force is exerted, although the extent to which it manifests itself is subject to modifications from various causes, such as the alterations which take place in the physical condition of matter, in consequence of chemical changes.

The development of heat by chemical action was illustrated by a series of experiments. Hydrochloric acid was poured upon oxide of zinc in a glass vessel, coated on the outside with a red fusible material. The heat generated by the union of these substances was rendered evident by the

melting of the fusible coating. Into another glass vessel, partly coated with the red, and partly with a more fusible green material, an acid having less affinity for the oxide of zinc (acetic acid) was poured. The heat generated in this instance, although not sufficient to melt the red coating, readily liquefied the more easily fusible green material. Some of the instances in which water exhibits active chemical properties were next selected as illustrations of the production of different degrees of heat by chemical action. Some water was mixed with sulphuric acid; the heat generated was sufficient to ignite a piece of phosphorus, placed in a long-necked flask and immersed in the mixture. Some water was added to anhydrous sulphate of copper, when the heat produced also ignited phosphorus. The more intense action of water was shown by letting a few drops fall upon anhydrous phosphoric acid; a noise was produced as as of water falling on to a hot iron, and some gun-cotton placed underneath the acid was instantly exploded.

The foregoing experiments were examples of heat generated by comparatively moderate chemical action. As instances of more violent action, productive of sudden and intense heat, thin copper leaf (Dutch gold) was introduced into chlorine gas, which resulted in the instantaneous ignition of the metal. A small piece of potassium was dropped into bromine, when the two combined with explosive violence.

The Lecturer proceeded to state that is often necessary for the attainment of the fullest effect which may result from chemical attraction between different bodies, that means should be applied for promoting the intimate contact of the particles between which this chemical attraction exists. This might be accomplished in various ways; thus, the minute division of one or both substances greatly promoted chemical action between them. This was exemplified by placing on the table a piece of phosphorus, and showing that it might remain for a considerable time in contact with the air without ignition, but when it was diffused in a finely divided state through the particles of a piece of bibulous paper, its exposure to air was attended by its immediate combustion. A bright piece of lead is readily tarnished by exposure to air, from the production of a superficial coating of oxide, but the action of oxygen upon the metal being thus very slowly exerted, the heat resulting from this combination is carried off as fast as it is generated, so that the energy of the action is not accelerated. But if lead be exposed to the air in a fine state of division, it undergoes such rapid oxidation by intimate contact of a large surface with the air, that it is immediately ignited. Iron affords another example of the effect of mechanical division in promoting chemical action. The rusting of iron is very gradual, and to obtain anything like rapid oxidation of a mass of iron, it is necessary to raise it to a white heat, and even then the combustion of the iron is of brief duration; but if particles of iron be detached from a mass by filing, these will be oxidised the instant they come in contact with flame; the contact between the metal and oxygen being greatly increased. A quantity of iron filings were allowed to fall through a spirit flame; the particles were instantly oxidised and a shower of sparks was the result. Iron may be obtained in so fine a state of division as to be instantly oxidised by simple contact with air at the ordinary temperature. Thus on breaking the end of a tube containing pyrophoric iron, and allowing its contents to fall to the ground, the fine particles of iron become red-hot in consequence of their combination with the oxygen of the air.

These experiments were examples of the reaction of gaseous and solid bodies, and the advantages to be derived from a fine state of division of the solid. The effect of minute division in promoting combination between solids and liquids was illustrated by means of mercury and sulphur. These two bodies might remain in contact for a considerable time without any appreciable result, but upon shaking mercury and flowers of sulphur together in a tube, and thus dispersing the finely divided liquid through the powdered solid, sufficient sulphide of mercury was speedily produced to blacken the whole of the mass. That this was not due to the mechanical division of the mercury was rendered evident by shaking mercury in a tube with a yellow powder, for which it had not any chemical affinity.

The great resistance offered by the particles of two solids to intimate contact renders it possible for solid bodies having a great affinity for each other to be intimately mixed together in the state of the finest powder, and for the mixture to be preserved for a long time without change. In such cases, however, the employment of a little pressure or friction is sufficient to set up chemical action; sometimes by effecting a closer approximation of the particles, or by generating heat sufficient to rouse chemical force into activity. Thus amorphous phosphorus and powdered chlorate of potash were intimately mixed with a card without any chemical result; but by subsequently applying slight pressure to the mixture combination ensued with explosive violence. As another example of the application of friction to induce rapid combination, sulphur and chlorate of potash were rubbed together in a mortar. The effect of friction in promoting chemical action may be partly due to the influence of the heat which is generated, and partly to the more intimate contact of the particles thus suddenly effected between small portions of the substances operated upon. The effects of a concentration of pressure upon a small surface, or one point, in establishing chemical action were exemplified by means of detonating compositions of different degrees of sensitiveness compressed in little wooden capsules; the smooth point of a needle was inserted into each composition; upon then allowing a weight in a suitable apparatus to fall upon the heads of the needles from different heights the sudden pressure exercised by the needle-points effected the ignition of the compositions. The Lecturer next alluded briefly to the influence of the solvent power of certain liquids in promoting chemical action between solids. Thus water has the power of blending together the particles of different solids which it can dissolve, and of thereby bringing them into much closer contact than is possible by any mechanical operation. The effect of solution was illustrated by pouring a little water on a colourless mixture of nitrate of mercury and iodide of potassium, when the immediate production of iodide of mercury was rendered evident by its characteristic scarlet colour. A second experiment in which nitrate of lead was substituted for chloride of mercury, was followed by the production of yellow iodide of lead. In these cases the heat resulting from chemical action was comparatively slight, in consequence of the moderate action of the substances upon each other, but that heat results from the chemical action between substances established by means of solution was shown by pouring water on to a mixture of finely powdered oxalic acid and oxide of zinc; the immediate increase of temperature was rendered manifest by the immersion of an ethereal thermometer into the mixture.

Attention was next directed to the means by which chemical action between gases is promoted. Their physical condition is frequently so unfavourable to their spontaneous union, or their energetic action upon one another, that some external influence is generally necessary to establish it. Thus chlorine and hydrogen, though possessing a most powerful affinity for each other, may be preserved in a state of mixture until exposed to the effect of light, when combination will take place between them with a rapidity in proportion to the nature of the light. Hydrogen and oxygen, on the other hand, may be preserved in a state of mixture and exposed to light for any length of time without undergoing combination.

Gaseous mixtures which are not affected by light may sometimes be brought under the influence of chemical force by effecting their partial condensation, and thus overcoming the repulsive tendency which appears to exist among their particles. Several porous bodies have the power of collecting and condensing considerable volumes of gas, and there appears little doubt that many important chemical changes are constantly promoted in nature by their agency. Char-

coal possesses to a remarkable degree the power of absorbing and condensing many gases; thus freshly ignited charcoal absorbs about 90 times its volume of ammonia, 35 times its volume of hydrosulphuric acid gas, and 9 times its volume of oxygen. If therefore a fragment of charcoal be introduced into a mixture of oxygen with ammonia or sulphuretted hydrogen, the mixed gases are simultaneously condensed, and their particles are thus brought within the sphere of action of chemical force; the result being the formation of water and of products of oxidation of the sulphur or nitrogen. This effect of charcoal was illustrated by introducing a fragment of charcoal, which had been previously saturated with sulphuretted hydrogen, into a tube of oxygen standing over mercury. The results were the production of aqueous vapour which condensed in the interior of the glass, and the gradual disappearance of the oxygen gas. An expansion of the gas observed in the first instance was due to the heat developed by the combination of the gases in the pores of the charcoal. Another substance possessing to a high degree the power of condensing gases within its pores is platinum, particularly when in the spongy state. A compound of this metal with volatile substances such as in the ammonio-chloride of platinum was heated to redness, when the porous metal thus obtained was held on a piece of paper, over a jet of hydrogen; this gas on passing through the paper was instantaneously condensed, at the same time that oxygen was collected from the air by the metal. A union of the two gases was thus rapidly effected, and the heat resulting speedily raised the metal to a red heat, whereby the jet of hydrogen was inflamed. A ball of spongy platinum being introduced into a mixture of oxygen and hydrogen immediately caused its explosion. Another illustration of the power of platinum to promote chemical action between gases and vapours consisted in placing asbestos coated with platinum, over a vessel containing ether. In a short time the heat resulting from the rapid oxidation of the ether vapour was sufficiently intense to cause portions of the asbestos to become red-hot.

Heat is an important agent for bringing about chemical action between gaseous liquid or solid bodies, which, when once established, developes heat sufficient to induce the continuation of the action with energy throughout its whole mass. The degree of heat required to establish its chemical action differs according to the nature of the substances and their affinities for each other. This was illustrated by means of three jars containing different explosive gaseous mixtures; on introducing a warm iron rod into two of them no effect was produced, but the third containing a mixture of bisulphide of carbon vapour and oxygen was immediately ignited.

Another iron rod heated to low-redness inflamed a mixture of hydrogen and oxygen, but did not affect a third mixture consisting of coal-gas and oxygen, which, however, was finally exploded by contact with flame. The effect of heat in establishing chemical action between gases and solids, and the influence of minute division of the latter in promoting the energy of the action, were exemplified by referring in the first instance to the combustion of a fragment of charcoal in oxygen gas (in which the chemical action, although brilliant, is comparatively gradual), and by afterwards applying a light to a jar of oxygen gas in which finely powdered charcoal had been shaken up, when a brilliant combustion of the suspended charcoal took place almost instantaneously throughout the jar. On performing a corresponding experiment, in which an inflammable material (powdered resin) was substituted for the charcoal, the combustion took place instantaneously with explosive violence. In summing up the Lecturer showed, in the case of solids possessing a tendency to act chemically upon one another, that the application of heat to any portion sufficed to establish chemical action throughout the whole mass of a mixture of such substances (*e. g.* gunpowder), provided the other conditions pointed out in the lecture as favourable to the display of energetic chemical force had been fulfilled.

SOCIETY OF ARTS, *Wednesday*, 9 *May* 1860.

THOMAS BAZLEY, *Esq. M.P. in the Chair.*

AT this meeting of the Society of Arts, Dr. J. FORBES WATSON, the Reporter on the Products of India, read to a large and attentive audience his long-deferred paper *On the chief Fibre-yielding Plants of India*, the value of which, both in a scientific point of view and as an impetus to one of the most important branches of our industry and commerce, can hardly be over-estimated.

Dr. Watson's communication to the Society was of such length, and embraced so wide a range, that we shall be compelled, although reluctantly, to omit a large portion, more especially the commercial statistics, for which, however, our readers will scarcely feel any special interest. At the commencement of the paper, the essential characteristics of endogenous and exogenous fibres were clearly defined then, turning to their microscopic appearance, the Lecturer said:—

"In judging of the quality of fibres, in all probability much depends on the constitution of the cell walls. The physical appearance, the power of resisting strains under certain conditions, separability, behaviour when exposed to the influence of moisture, in these, great differences exist betweeen the fibres of exogens and endogens, and these must be taken into account in judging of the relative value of the two divisions. Fibres from endogens present a characteristic white appearance, and when examined under the microscope are, with one or two exceptions, readily distinguished from exogens. The isolated fibres are less transparent, arising from the depositions of a larger quantity of what has been called encrusting matter, or from the deposition of lignine in the interior. These deposits, whatever their nature be, seem as if fractured at innumerable places. Some of them also present a characteristic opalescence not found in others. The ultimate fibre cells too are, as a rule, separable with difficulty, and are brittle when compared with exogens, and this has an important influence both upon their suitability for spinning and papermaking. With the valuable assistance of Mr. Wentworth L. Scott, whom I have entrusted with the preparation of the various fibres for my examination (and who has throughout superintended the execution of the cuts)[1], I have submitted the whole of them to repeated and careful microscopic inspection under various conditions, and I believe that the descriptions which accompany each will be found very fairly to represent their characteristic differences, although it is impossible by language always to express the character which strikes the eye.

"The importance of the microscope in such investigations is obvious. It enables us to detect in different fabrics the existence of fibres of an inferior class.

"In addition to such aids as are afforded by the microscope, the eye, and the touch, we have certain other practical tests of the quality of fibres arising from their behaviour under mechanical treatment. But, before considering the fibres themselves, I would make a few remarks upon the mode of separating them from the parent stems, reserving further comment until treating upon individual fibres. I have at the present moment in my possession no less than 180 specifications of patents bearing upon this important subject. The analysis of these and the discussion of the various processes adapted to the purposes of cleaning and preparing fibrous substances would occupy the whole of the time at my disposal this evening. I shall therefore only indicate principles. But to understand the process of cleaning Indian fibres, it must be remembered that we have to deal with a climate in which fermentation and putrefaction readily succeed each other in the freshly-cut plant. A forgetfulness of this fact has acted injuriously upon their value. The common practice has been to steep the plant in

[1] For the loan of the woodcuts which illustrate this paper we are indebted to the kindness of Dr Forbes Watson: Mr. W. L. Scott has been responsible for their arrangment in these pages.—ED.
The woodcuts here referred to have been executed by Mr. Orrin Smith.

water, until the sap is decomposed. Labour is thus saved, but in India the fibres are often irreparably discoloured and weakened for manufacturing purposes. It is therefore obvious that steeping, if employed, should be for the purpose of loosening and dissolving the binding constituents of the plant.

"And now as to climate and soil:—

"In endeavouring to illustrate the capabilities of a given country for the growth of certain plants, two lines of inquiry present themselves. We have in the first place to show that the soil and climate are suitable, and afford the fundamental conditions necessary to full development; and in the second, to indicate with what success a particular product has been already cultivated. As regards climate, no country in the world of equal extent is so favoured as Hindostan. This arises to a great degree from the physical inequalities of its surface, without which India would have been a vast desert. The Himalayas, rising in height from 20,000 to 29,000 feet, act as the great modifiers of temperature, and provide proper water supply to the rivers in the north, as well as to the atmosphere: while the Malabar range of mountains, and the Eastern Ghauts, rise abruptly in their turn, and produce similar effects.

"Then again, as a rule the growth of plants for their fibres is more exhausting to the soil than that of any other crop. In the case of ordinary food substances, the seed alone is removed, and the constituents of the straw or stem which furnished the seed, in all good husbandry, are again restored to the soil. For effective nutrition it is essential that not only should the soil contain the elements necessary for perfecting the seed, but likewise in equal abundance the constituents of the stem. The amount of constituents required for the vigorous growth of different plants varies considerably; but it would seem that all of like species, wherever grown, require the same constituents to be furnished by the soil. Thus in the case of flax, we find from an examination of the mineral constituents of the whole plant, that certain soils are more abundantly present than others, and we may fairly conclude that the soils which afford the largest supples are, always supposing climatic conditions to be favourable, the best adapted for the cultivation of such.

"The suitability of our Indian soils to the growth of cotton, afforded me an opportunity, on a former occasion, of pointing out the general features of the country, with respect to its surface, and to this I would again refer.

"Although subject to considerable modifications, the soil of India may be divided into three great classes. In the North, we find great alluvial tracts, the results of countless ages of deposits from those majestic rivers, the Ganges, the Indus, and the Brahmapootra, which, together with their contributaries, fall respectively into the Bay of Bengal and the Indian Ocean. By this alluvial India may be said to be bounded on the north; but passing southward and eastward from the delta of the Indus, we find the rivers of Guzerat and the intractable Nerbudda have each afforded its quota to the same class of deposits. On the opposite side of the country the mouths of the Godavery, the Kishna, the Cauvery, and sister rivers, supply soils identical in physical character; and stretching still further to the eastward to Burmah, extended evidence presents itself of that ceaseless attrition which at last subjugates the hardest rocks.

"It is not possible for me to say exactly, or, indeed, with any amount of precision, how much of the 1,200,00 square miles which comprise Hindostan consist of the deposits here referred to, but I believe at least one-third does so.

"The soil next in amount, and equal if not superior importance, is the well-known 'black cotton soil' of the Deccan and other parts of India. In amount it occupies a position next to the alluvial. It stretches from Bundelcund in the north nearly to the south of the peninsula. A very considerable portion of the Deccan consists of this; it is also to be found in Guzerat and many other parts of the country. In depth it varies much. As to origin, it seems to have arisen from the decomposition of basalt and trap, which constitute, to a great extent, the mountain ranges on which the great plains of the Deccan are elevated.

"In depth it varies from 3 to 15 feet or more.

"The third characteristic soil is usually called 'red.' It is found in all parts of the country, but perhaps chiefly in Southern India, where it apparently mainly arises from the decomposition of granite rocks. Its lime and some valuable constituents are, however, obtained from different sources. In other parts of India this soil would seem to take for its origin rocks of a volcanic description, such as the red jaspery brick-like *Laterite*, which is found extensively in many parts of the country.

"In proceeding to remark on the various analyses shown in the tables we observe that the soils of India differ in some respects from the best known cultivated ones of Europe. No feature is more remarkable than the comparative absence of organic matter, and the state of comminution so common to them. Whole tracts of country may be said to consist, as regards their surface, of impalpable powder when dry, or of tenacious mud when moistened. So strongly argillaceous are many, that they bake into a hard brick-like mass when exposed to the sun. A common and very important feature attaches to the generality. Potash and soda are so abundantly present as to furnish almost exhaustless amounts. Sulphates and chlorides would seem to be defective, but these are supplied by the irrigating waters of the various rivers.

	Bengal.				
	Rajpoor.	Cawnpore.	Lucknow.	Tirse.	Bomoree.
Moisture at 212°	1·470	3·170	1·500	2·860	1·083
Water above 212°, and organic matter	1·130	0·370	2·400	0·140	1·247
Potash	1·570	0·445	0·193	0·578	0 614
Soda	1·162	0·582	0·050	0·383	0·590
Lime	0·208	3·930	36·405	0·224	1·420
Magnesia	0·400	0 240	0·270	0 308	0·100
Alumina	9·100	13·560	2·870	11·030	9·180
Peroxide of iron	5·410	3·770	3·270	1·400	1·350
Chloride of sodium	0·041	0·051	trace	0·033	0·023
Phosphoric acid	0 088	0·121	trace	0·023	0 041
Sulphuric acid	0·018	0·003	trace	0·001	0·021
Carbonic acid	—	1·200	26·202	0·200	trace
Silica, as silicate and as silex	79·670	72·842	28·290	80 130	83·950

"The soils of the Punjab and of Sind we find very much alike. In colour of a light drab, physically almost impalpable. With some 20 per cent. of alumina and oxide of iron, they are stiff in character, and readily turned by water into a thick mud. Carbonate of lime and magnesia exist in very large quantities; and when we take into consideration the

	Gurchamer.	Between Panagurh and Jubulpore.	Khamlepur.	Bellary.
Moisture at 212°	16·000	10·700	17·000	12·000
Water above 212°, and organic matter	0·200	—	0·460	0·260
Potash	0·720	0·573	0·813	9·332
Soda	0·529	1·719	0·779	0 774
Lime	2·190	1·680	5 610	6·350
Magnesia	1 440	0 720	0·143	0 290
Alumina	23·292	16·660	19·930	13·330
Peroxide of iron	13·438	6 000	11·400	5·330
Chloride of sodium	0·055	0·053	0·053	0 055
Phosphoric acid	0 008	0·166	0·038	0·101
Sulphuric acid	0 003	0·071	0·014	0·034
Carbonic acid	0·200	0 200	0 980	4·060
Silica, as silicate and as silex	41·930	61·500	41·738	57·330

INDIAN SOILS[1] CONTRASTED WITH EUROPEAN FLAX SOILS.—1. INDIAN SOILS.

WHENCE PROCURED.				COMPOSITION.																CAPACITY FOR MOISTURE. Soil dried at 212° and exposed for 12 hours in air at 80° saturated with moisture absorbed.	
Territory.	District or Tract of Country.	Locality.	Remarks.	Water above 212° and Organic Matter.	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Iron (peroxide).	Chloride of Sodium.	Chlorine in Chloride of Sodium.	Phosphoric Acid.	Sulphuric Acid.	Carbonic Acid.	Silica, (readily soluble.)	Silica as Silex, and as Silicates.	Moisture.		Analyst.	
				Per cent.	Per cent.	Per cent	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.		
Punjab	Baree Doab, between the Ravee and Sutlej	Lahore	Cultivated and irrigated	0·930	1·029	0·722	3·920	1·910	12·660	10 000	0·036	0·0218	0·132	0·024	1·760	-	63 800	3 930	4 070	Bernays.	*a*
,,	,,	,,	From 5 ft. below surface of last	0·500	1·820	1313	4·670	2 010	14·630	4·100	0 033	0 0200	0 097	0.030	2·400	0·740	65 970	2·160	2 160	,,	*b*
,,	,,	Serdarpoor	Cultivated	2·000	0·933	0.410	2·439	1 001	11 230	11 700	trace	trace.	0·100	trac	1 631	-	69 240	2·000	1·250	Manning.	
,,	,,	Mooltan	Uncultivated-covered with grass	1 520	2·240	0 801	2·150	0·443	12·980	8 010	0·055	0·0323	0·117	0 041	0 720	0·970	69 030	1·860	2·340	Bernays.	*c*
,,	,,	,,	From 3 ft. below surface	1·370	2·130	1·232	2·480	0·590	14·150	6·140	0 078	0 0475	0·109	0·055	1 400	-	68 670	1·090	1·380	,,	*d*
,,	Jetch Doab, between the Jhelum and Chenab	Kot Isa Shah	Cultivated, not manured	2 410	0·520	0·213	5·491	1·330	12·260	6·310	trace	trace	0·043	trace	4·317	-	66 640	1·750	2·000	Manning.	
,,	Sind Saugur Doab, between the Indus and Jhelum	Near Rawul Pindee	Ordinary cultivated soil	2·840	1·038	0·404	7·480	0·720	17·890	5·110	0·074	0·0449	0·107	0 075	0 512	1·870	57 630	4·430	4·100	Bernays.	*e*
Sind	West of Indus	Larkhana	Good cultivated soil	2·300	1·103	0·620	5·331	0·560	15·850	14·710	trace	trace.	0·060	trace	4·208	-	54·940	3·000	4·000	Manning.	
Eastern Bengal	Near the Megna	Five miles east of Koralea	Regularly inundated—Cultivated during 8 months of the year	1·190	0·598	1·656	1·490	1·430	17·440	4·890	0·020	0·0120	0·132	0·052	-	-	67·000	4·160	4·120	Bernays.	*f*
,, ,,	On the Surma, near to junction with Brahmapootra	Rajaganj	Cultivated — inundated during rains	1·730	0·786	0·686	0·890	1·240	16·270	3·460	0·016	0·0090	0·082	0 004	-	1·400	70 600	2·930	2·480	,,	*g*
,, ,,	Left side of Brahmapootra	Opposite Jairampoor	Cultivated—inundated	1·950	0·664	0·513	trace.	0 240	22·240	5 ·200	0 053	0 0320	0·015	0 020	trace.	0·650	61 855	6 750	5·130	,,	*h*
,, ,,	Most Northern Part of Brahmapootra Delta	Jumalpoor	Cultivated—inundated at period of removal of specimen	1·780	0·450	0·253	0·084	0 232	14·010	7·040	0·041	0 0247	0·125	0·005	0·130	0·380	71·170	4·700	5·000	,,	*i*
Assam	Brahmapootra river system	Near to Debroogurh	Used for tea cultivation	0·c20	0 820	0·758	2·530	0 740	16 550	7·850	0 022	0·0133	0 115	0·001	trac .	-	65 046	5 700	4 150	,,	*j*
,, ,,	,, ,,	,,	Occasionally cultivated — never manured	0·130	1 1	0 1·795	0·890	1·450	17 470	4·530	0 029	0·0176	0 042	0 003	0 006	3·720	64 980	3·330	3 240	,,	*k*
,, ,,	Island in the Brahmapootra	Machulee, near to village called Salamara	"Plastic clay"—cultivated	1·500	0 2	0·0·167	trace.	1 210	29·630	3·570	0·025	0·0152	0·058	0 004	0 080	-	55·330	5·830	5·040	,,	*l*
,, ,,	Eastward of Debroogurh	Bijitollia	Indifferent tea soil, from close to the shore	1·440	0·700	0·043	0·224	0·500	12·830	9·660	0·033	0·0200	0·063	0·006	0 040	0·400	69·260	3·970	2·680	,,	*m*
Bengal	Three miles east of Bhagulpore	Rajpoor	Cultivated — not manured — extends over a large surface	1·130	1·570	1·162	0·208	0·400	9·100	5·410	0·041	0·0247	0 088	0 018	-	0·345	79·325	1·470	1 360	,,	*n*
N. W. Provinces	Ganges river system	Cawnpore	Cultivated—not manured	0·370	0 445	0·582	3·930	0·240	13·562	3·770	0 051	0·0309	0 121	0·001	1·200	-	72·842	3·170	2·780	,,	*o*
Oude	,, ,,	Lucknow	"Fertile soil"	2 400	0·193	0·050	30·405	0.270	2·870	3·270	trace	trace.	trace	trace	26 202	-	28·290	1·500	2·000	Manning.	
Bundelcund	72 miles N.W. from Saugor	Teree	Good wheat soil—covers large area	0·140	0·578	0·383	0·224	0·308	11·930	1·400	0 033	0·0200	0·023	0 001	0 200	1·300	80·130	2·860	2·770	Bernays.	*p*
,,	93 ,, ,, from ,,	Bomoree	Good, but rather stony — extends over a large surface	1·247	0·614	0·590	1·420	0·100	9·180	1·350	0·021	0·0139	0 041	0 021	trace.	0·050	83·950	1·083	0 847	,,	*q*
Malwa	Central India	Gurchamer	Good cotton soil—not manured	0·200	0·720	0·529	2 190	1·440	23·292	13458	0·055	0·0333	0·008	0·001	0·200	0 720	41·210	16 000	13·090	,,	*r*
Saugor & Nerbudda	,, ,,	Between Panagurl & Jubbulpore	Good cotton soil of great extent — not manured	none	0·573	1·719	1·680	0·720	16 660	6·000	0·053	0·0310	0 166	0·071	0·200	1·000	60 500	10 700	7 460	,,	*s*
Deccan	Right shore of Kistnah	Khamlepur	Good black cotton soil — not manured	0·460	0·813	0·779	5·610	0·143	19 930	11·400	0·053	0·0320	0 038	0·014	0 980	2·640	19 098	17·000	12·441	,,	*t*
Mysore	Southern India	Bellary	Good black cotton soil	0·260	0 312	0 774	6·350	0·290	13·330	5·330	0 055	0·0333	0 101	0 034	4 660	-	57 330	12·000	9·045	,,	*u*

2.—EUROPEAN FLAX SOILS.

Russia	Livland			4·717	0·501	-	0 375	0·201	12·990	1·807	0 045	0·0273	0 140	0 154	-	-	79 342	-	-	Mayer & Brazier.
,,	Courland			4·030	0·324	0·132	2·654	0·130	7·987	2·376	0 024	0·0145	0 054	0 088	-	-	81 500	-	-	
,,	Lithuania			4·344	0·546	0 045	1·375	0·180	24 591	3·190	0·042	0·0254	0·080	0·120	-	-	85 200	-	-	
,,	Estland			4·868	0·372	0·048	2·807	0·361	7 765	2 020	0 079	0·0479	0 159	0 162	-	-	80 560	-	-	
Belgium	Heestert			3·123	0 160	0·298	0·357	0·262	17·012	3·208	0·017	0·0103	0 121	0 025	-	-	75 080	-	-	Kane.
,,	Ecamaffles			2·561	0·121	0 146	0·227	0·153	10 661	1 663	0·330	0·0181	0 152	0 017	-	-	84 065	-	-	
,,	Hamme Zog			4·209	0 058	0·110	0·481	0·140	5·885	1 202	0 067	0·0426	0 064	0 013	-	-	86 797	-	-	
,,	Not named			3·672	0·151	0 206	0·366	0·142	5·388	1·543	0 009	0·0054	0 193	0 026	-	-	88 185	-	-	
Holland	,, ,,			5·841	0 583	0 326	3·041	0·105	22 706	6·047	0·023	0·0139	0 159	0 023	-	-	60 947	-	-	

[1] A portion of those which have been selected for analysis from an extensive collection made for the Indian Government by the Messrs. Schlagintweit.

a A light drab coloured impalpable soil. *b* A very light drab coloured soil, almost impalpable. *c* A light drab coloured impalpable soil. *d* Very similar to 6 in colour and properties. *e* A drab coloured soil; very dense, but reducible by water to a paste. *f* A drab coloured soil, with a reddish hue, almost impalpable. *g* A very light brown soil, somewhat lumpy, reducible by water to a paste. *h* A red soil, lumpy, with much silex; stiff. *i* A yellowish brown soil, with much silex. *j* A very peculiar micaceous soil of red colour. *k* A drab coloured soil, approaching whiteness, impalpable almost. *l* A drab coloured soil, approaching whiteness, almost impalpable; very stiff. *m* A light reddish-brown soil, micaceous; very fine, but not impalpable. *n* A very light brown soil, almost impalpable. *o* A drab coloured micaceous soil, very finely divided. *p* A deep drab, very lumpy, much silex. *q* A light sienna brown soil; much silex. *r* An olive brown soil, rather gritty, yet very dense. *s* A brown lumpy soil, much silex. *t* A deep sepia brown soil, with some coarse silex. *u* A deep slate coloured soil, with silex and chalk particles, &c.

SOILS FROM LAHORE, SIRDARPOOR, MOOLTAN, &c.

	Punjab.						Sind.
	Lahore.		Serdarpoor.	Mooltan.		Kotisashah	Rawul Pindee.	Larkhana.
	Soil.	Subsoil.		Soil.	Subsoil.			
Moisture at 212°	3·930	2·160	2·000	1·860	1·090	1·750	4·430	3·000
Water above 212°, and organic matter	0·930	0·500	2·000	1·520	1·370	2·410	2·840	2·300
Potash	1·029	1·820	0·933	2·240	2·130	0·520	1·038	1·103
Soda	0·722	1·313	0·410	0·801	1·232	0·213	0·404	0·620
Lime	3·290	4·670	2·439	2·150	2·480	5·493	7·480	5·331
Magnesia	1·910	2·010	1·001	0·443	0·590	1·330	0·720	0·560
Alumina	12·660	14·630	11·230	12·980	14·150	12·260	17·890	15·850
Peroxide of iron	10·000	4·100	11·700	8·010	6·340	6·310	5·110	14·720
Chloride of sodium	0·036	0·033	trace	0·055	0·078	trace	0·074	trace
Phosphoric acid	0·132	0·097	0·100	0·117	0·109	0·043	0·107	0·060
Sulphuric acid	0·024	0·030	trace	0·041	0·055	trace	0·075	trace
Carbonic acid	1·760	2·400	1·631	0·720	1·400	4·317	0·512	4·208
Silica, as silicate and as silex	63·800	66·710	69·240	70·000	68·670	66·640	59·500	54·940

	Eastern Bengal.				Assam.			
	Five Miles East of Koralia.	Rajaganj.	Opposite Jaliampoor.	Jumalpoor.	Near to Debroogurh.		Machulee.	Bijitollia.
					For tea.	Occasionally Cultivated.		
Moisture at 212°	4·160	2·930	6·750	4·700	5·700	3·300	5·830	3·930
Water above 212°, and organic matter	1·190	1·730	1·950	1·780	0·020	0·130	3·500	1·440
Potash	0·598	0·786	0·664	0·450	0·820	1·810	0·620	0·700
Soda	1·656	1·686	0·513	0·253	0·758	1·795	0·167	0·043
Lime	1·490	0·890	trace	0·084	2·530	0·890	trace	0·224
Magnesia	1·430	1·240	0·240	0·232	0·740	1·450	1·210	0·500
Alumina	17·440	16·270	22·240	14·010	16·550	17·470	29·630	12·830
Peroxide of iron	4·890	3·460	5·230	7·040	7·850	4·530	3·570	9·660
Chloride of sodium	0·020	0·016	0·053	0·041	0·022	0·029	0·025	0·033
Phosphoric acid	0·132	0·082	0·015	0·125	0·115	0·042	0·058	0·063
Sulphuric acid	0·052	0·004	0·020	0·005	0·001	0·003	0·004	0·006
Carbonic acid	none	none	trace	0·130	trace	0·006	0·080	0·040
Silica, as silicate and silex	67·000	70·600	62·505	71·550	65·046	68·700	55·330	69·660

plants usually cultivated, phosphates are present in sufficient quantity. Contrasted with European soils, there is a falling off in the amount both of sulphates and chlorides.

"The soils of Eastern Bengal are somewhat peculiar. The lime present in them is chiefly in the form of silicate, carbonates being almost altogether wanting. They seem, too to be much more dependent upon the inundating waters for supplies of sulphates and chlorides. In clay they abound; consequently they are more retentive, and have fully more capacity for moisture than the soils of the Punjab. As to silex too a great difference is observable, so that in many cases the presence of pebbles greatly detracts from the otherwise too great stiffness. Though less rich than the Punjab soils in potash and soda, they may yet be said to abound, being richer than those of Europe in which flax is successfully cultivated. Other observations might be made, but the agricultural reader will fairly deduce these for himself on comparison of the soils of Eastern Bengal from the other localities specified. It will be observed from the larger table that all are inundated, either during rains or for stated seasons.

"The soils of Bengal almost speak for themselves. The one from Lucknow is peculiar, being distinctly calcareous. The two soils from Bundelcund are very loose in texture.

"The cotton soils from Malwa, Saugur, Deccan, and Mysore have quite a distinctive character. They are for the most part very dense, and contain not only much moisture, but have great power of absorption; and this has a most important bearing on the question of irrigation. In the black soils it is evident that irrigation must be employed with great caution, if at all. In organic matter they are strangely defective, especially when comparing them with dark-coloured European soils. Of potash and soda they contain abundance."

Next followed some observations upon the classification of fibre-yielding plants adopted by various authorities, which we need not repeat; the commercial order preferred by Dr. Watson will be discovered from the description given hereafter. First on the list stands flax. In India the *Linum usitatissimum* is grown chiefly for its seed at the present time, but recently attention has been directed to the capabilities of certain parts of the country to furnish fibre of a very fine quality. The exhaustive nature of flax is well known, it requiring so large an amount of the alkalies for its proper development; that potash and soda, however, are abundantly present in the great alluvial soils of India a glance at the Table will show.

As regards the cost of flax in the Punjab "we have the authority of Mr. Steiner that flax can be produced on the spot at the rate of 20*l.* per ton, and that conveyance to the port of Kurrachee (from which it ought to be shipped direct to this country) will add 5*l.* thus increasing the cost to 25*l.*

"On the other hand, Mr. Cope holds that the estimate is too low, and that flax cannot at present, in the face of transit and other difficulties, be landed at Kurrachee under 32*l.* per ton. On this point I would remark that, even admitting that Mr. Cope's statement is nearer the truth than that of Mr. Steiner, if the flax produced is equal to what we have lately received it will bear even that expense, and not only prove

a more remunerative crop to the Punjabee cultivator, but also a positive boon to those interested in the flax trade."

After some further remarks upon the cost of culture and transit the Doctor said: —

"There yet remain many subjects of interest connected with flax were there time to refer to them. The preparation of the fibre is, however, too important to be overlooked. And first with respect to retting. It has been held that the process invariably deteriorates both the strength and quality of the fibre, and there can be no doubt that when improperly carried out such is the case. But when this process is carried to the extent simply of dissolving out certain binding juices of the plant, and leaving the fibre in a more separable state, no evil consequence will result; nevertheless, in India more than ordinary care is required to put the process in operation, particularly in the case of inexperienced hands; if adopted, it must for some time be carried on in retteries under skilful management. Machines have, however, been invented, and others are in course of construction, for the extraction of the fibre from the dried stem, without the previous action of either dew or water retting. Could these be only furnished at a reasonable rate (as is the case with the hand cotton gins, which have resulted from the operations of the Cotton Supply Association), so as to enable the cultivator to purchase or hire them without resorting to the means usually adopted, I believe a great impetus would be given to the development of flax culture. Flax thus prepared is, however, harsher to the touch, and less fitted for employment in the finer fabrics than when retted. As, however, by far the greater quantity of flax consumed in this country is expended on those coarser textures which chiefly require strength, it would be found that the larger quantity of flax so prepared would meet with a ready demand. If the finer qualities are wanted, there is abundant evidence that these can be produced by exposing the flax so prepared to the action or certain chemical steeps so as to impart the requisite softness and separation of the fibres. Several processes are in present use for this purpose, and samples so prepared are before us this evening. The expense of such operations is said to amount to about 10*l.* to 12*l.* per ton, while the improvement in the quality of the fibre increases its value to an extent which far more than counterbalances such preliminary expenses, always supposing that the expenses will remain at the same figure when the operation is carried out on an extensive scale. These are points, however, which I must leave to be discussed by those more immediately interested in a commereial point of view.

"One word as to the appearance of flax fibre under the microscope. It fortunately happens that while flax is, as far as we at present know, the best and most useful fibre of its class, it is at the same time the one possessed of so characteristic an appearance when submitted to the searching of this instrument that we can readily detect its admixture or adulteration, as the case may be, with fibres of an inferior quality. Under the ordinary manipulation, preparatory to microscopic examination, the toughness of the fibres and their ready divisibility into ultimate fibrillæ is ascertained. As seen at *a* Fig. I, it presents, at varying distances, certain characteristic cross-markings. The outlines of the fibres are hard and smooth, and the ultimate fibrillæ can seldom be detected until carefully detached from the ordinary fibres."

The Rheea of Assam, and the Neilgherry nettle (Urtica nivea, or tenacissima and U. heterophylla), were next described, the former being a shrub of some three or four feet high very easily propagated from cuttings. This plant called by the natives "Caloee," "Kunkamis," "Goun," and another variety known botanically as the *Boehmeria puya*, yield a very peculiar, strong, and fine fibre, well adapted both for spinning and for the manufacture of paper. According to Sir William Hooker it is the *Urtica nivea* which yield the well-known *grass-cloth* fibre. Mr. W. L. Scott, however, considers that a slight difference between the true China-grass and the rheea may be detected by the microscope. The rheea plant seems also very exhaustive, taking the following analysis of the stem ash by Dr. Hornidge as a criterion.

"The stems contained 8·61 per cent of moisture. The dry stems consist of: —

Carbon	47·279
Hydrogen	6·265
Nitrogen	00·90
Oxygen	42·229
Ash	4·137
	100·000

"The ash consists of —

Potash	32·37
Soda	16·39
Lime	8·40
Magnesia	5·33
Peroxide of iron	—·—
Chloride of sodium	9·13
Phosphoric acid	9·61
Sulphuric acid	3·11
Carbonic acid	8·90
Silicic acid (with little charcoal and sand)	6·60
	99·90"

On other points connected with the rheea, Dr. Watson said: —

"As to cost of production, I can make no positive statements. The value of the prepared fibre is, however, such as would most amply repay a very large outlay. It is impossible to embrace the many purposes for which the rheea is suited, although a notion may be formed from the samples of manufacture brought from Bradford, and now displayed. To the touch they present a peculiar roughness, owing to slight asperities on the surface of the individual fibres, which confer the property of allowing it to be readily spun into fine thread, as well as being mixed with, and spun on machinery adapted for woollens. It may be possible to mix it with our much-despised shoddy, and so to give the latter that strength which it so much lacks.

"Under the microscope (see *a*, Fig. II.), its fibres present the roughness already alluded to, and when viewed under reflected light have an appearance not unlike frosted glass. Considering their costliness, it is as well that all nettle fibres are readily detected by this instrument, as all indicate, with certain modifications, the same kind of structure."

Further on we learn various interesting particulars respecting the Neilgherry nettle, which we cannot do better than quote: —

"It is known by the various native names—Horoo Surat, Herpah, or Serpah, Bhootea, and Theng Mah. It is so similar to wool when crumpled up, that even merchants from a casual glance have not deteeted the difference, hence the common name of *vegetable wool* by which the plant is known. Under the microscope (*b*, Fig. II.), it indicates considerably greater asperities than in the rheea, consequently it is better suited for admixture with wool.

"This nettle has upright angular stems, covered with small prickles, and marked with small white specks. The leaves are similarly protected by bristles; they are irregularly serrate, long, variously lobed, petioled, and almost caudate at the base. From the severe injuries consequent upon a sting, greater difficulties are presented to obtaining its fibre than is the case with the Rheea. The natives on the Neilgherries first boil the plant before subjecting it to manipulation."

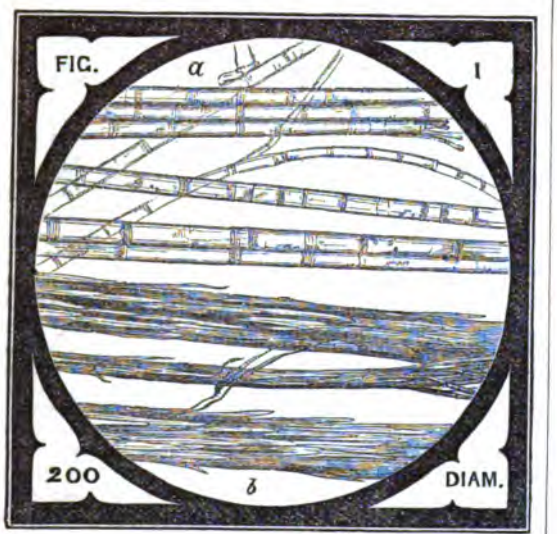
Next we come to the fibre of the Mudar (*Calotropis gigantea*), to which the extremely euphonious titles of *Yercum*, *Ak Mudar*, *Tella jilladoo*, are applied by the natives. The plant is perennial, very common in Indian jungles, and requires little or no culture. In the experiments of Dr. Wight the Mudar fibre took the first rank as regards strength. Microscopically (see Fig. III.) it somewhat resembles flax, the transverse markings excepted, but the ultimate fibres are readily seen within the ordinary fasciculæ. Here we quote again:—

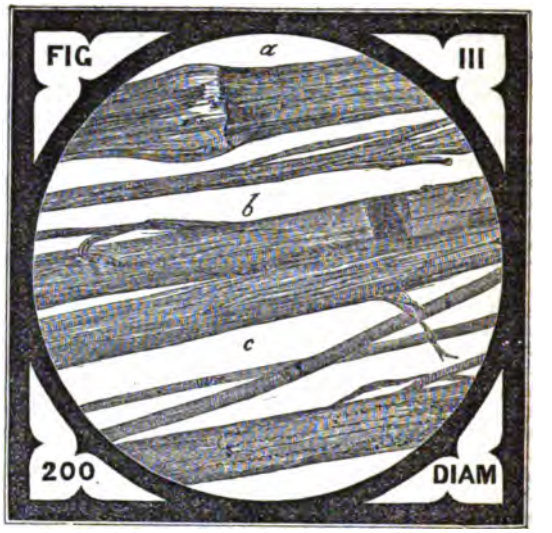
"As may be witnessed by the specimens upon the table, the finest fabrics can be manufactured from the Mudar; and

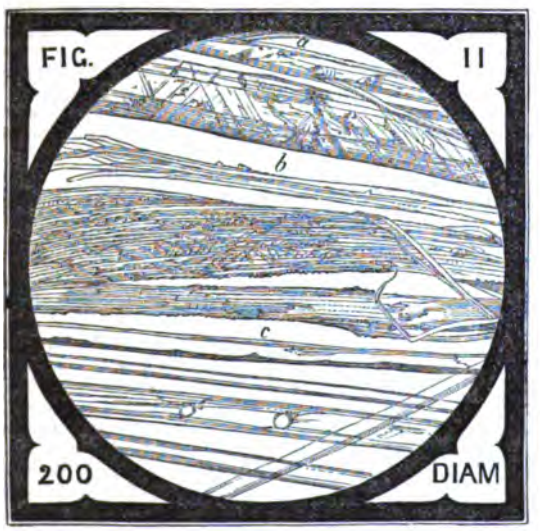
yet the fibre-extraction is the most difficult of any in India. The plant stems are succulent, and contain a quantity of juice of an acrid description, which is used as a medicine by the natives, and in addition a gum-resin, which Dr. Riddell has shown to possess many of the valuable properties of gutta-percha. It is, however, in all probability the acrid juice which so interferes with the separation of the fibres by any of the ordinary methods. Hitherto the fibres have had to be separated from the fresh plant by means of the fingers, and not only the native, but even Dr. Hunter's more elaborate methods have proved that steeping cannot be employed at all, for even short periods. The dissolved juices, arising from the lactiferous vessels, appear to act upon the fibres and to injure them. As long, therefore, as the fibres shall have to be separated by the hand, Mudar is not likely to come into general use. It is, however, possible that a method may be devised for removing the acrid juices from the fresh plant. But without such method the fibres can never take the rank for which they seemed designed.

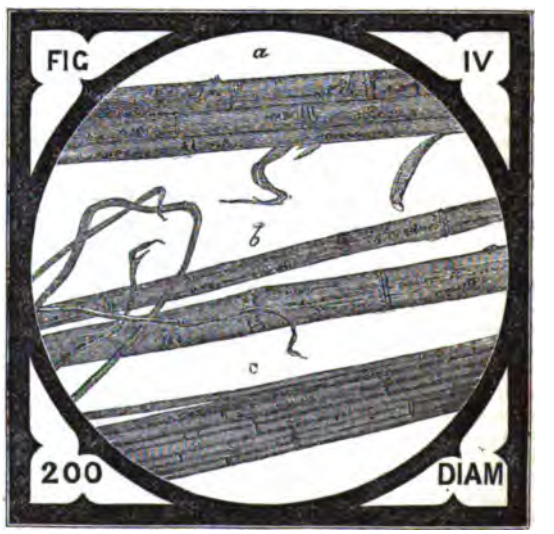
"The percentage yield of fibre seems small. The floss from the seed is useful for stuffing pillows; also, notwithstanding the smoothness and absence of twist in the fibre, for manufacturing into fabrics of a soft but unenduring description. It was long since suggested by Dr. Roxburgh as a substitute for silk, and it certainly seems to me a better one than the *Pulu* produced by a fern, and known by the name of vegetable silk, which is now exciting attention. At all events, it is deserving of trial.

The "*Bedolee Sutta*" of Assam stands next:—it is botanically called *Pederia fœtida*, the crushed plant exhaling a most unpleasant odour. The fibre obtained from this creeper is strong, delicate, and flexible, and lies in joints of varying distances apart. The plant is cut at each joint, and each separate length thus obtained is denuded of all bark, and then twisted repeatedly to disintegrate it more completely. The fibre itself is then slowly pulled away by the hand of the operator, a rather expensive process; but as children can be thus employed, it is not an impracticable one for India. Its appearance under the microscope is quite distinctive, being that of a solid and smooth cylinder, with few markings









(*c*, Fig. II.) If found suitable for spinning with our flax machinery, the value of this fibre is calculated to be from 150*l.* to 200*l.* per ton.

The next class of fibres is headed by jute, a piliaceous plant, of which two species, the *Corchorus capsularis* and *C. olitorius* (the latter called "*putta*" by the natives) afford the material of which the "*jute-ropes*" and "*gunny-bags*" of commerce are made. Jute is cultivated very largely in Bengal, and its fibre is separated by the process of water-retting. The product is not remarkable for strength, as it bears a transverse strain very badly. The microscope quickly distinguishes this fibre from flax, by its rougher outline, indefinite cross-markings, and comparative opacity. The ultimate cells have often a tongue-like ending (*b*, Fig. I.) In 1855-56, a year of large exports, India furnished about 270,000 tons of jute, raw and manufactured. The fibre which presents the most glossy appearance commands the best price in the market, although it is not the strongest variety.

At *a*, Fig. III. the microscopic appearance of the "*safet*," or "*Lal Buriala*" fibre of Bengal, the *viola rhomboieda* of botanists; it will be seen to exhibit a regular longitudinal structure, and is of an opaque and woody appearance; by reflected light it resembles in some degree the so-called *New Zealand flax*. The plant yielding this fibre belong to the mallow tribe, and the species in question grows rapidly, and in great abundance; in a single year three crops may be obtained. The Sida is stronger than jute, and worth some 5*l.* or 8*l.* more per ton.

The hemp-leaved Hibiscus (*Hibiscus cannabinus*) next claims our attention; the native nomenclature is varied and sufficiently unutterable, so we select "*Ambaree*" as the simplest appellation. Although easily cultivated, the hibiscus fibre is but little known commercially, the specimens hitherto imported having been badly prepared. Microscopically it is not unlike the Sida *b*, Fig. III.

The next group of fibres introduced to our notice were suitable for twine, cordage, &c. Hemp standing foremost on the list. This well-known dioecious plant is cultivated in India, in the Punjab, and the Himalayas, but chiefly for the "bhang" it yields—an intoxicating resin exuding from the leaves. The seeds are sown about the end of May and beginning of June; the plants require much attention and careful manuring. In point of strength the Himalayan hemp is superior to the best Russian samples. In Fig. IV. the microscopic appearance of hemp is well shown, the letters *a*, *b*, *c* representing specimens from Russia, the Himalayas, and Italy respectively: in hemp the transverse striæ are generally fewer, and less marked than in flax, which it in other respects resembles.

(*To be continued.*)

CORRESPONDENCE.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Isomorphism of Bismuth with Antimony and Arsenic.—M. Nickles[1] has found that the iodide of bismuth BiI_3 obtained directly in the crystalline state possesses the same form as the iodides of antimony and arsenic. Similar in composition, properties, and functions, and identical in crystalline form, the iodides of bismuth, antimony, and arsenic combine all the characters of truly isomorphous bodies. Here then are additional reasons for placing bismuth in the nitrogen group with which it is connected by antimony, arsenic, and phosphorus, which form the intermediate steps. Bismuth therefore is a "*demi metal*;" with tellurium, antimony, arsenic, and tungsten it stands between the metalloids and the metals. The author remarks besides, that, like the above, bismuth is neither ductile nor malleable, so that the property of flattening under the hammer is never absent in any of the simple bodies whose *metallity* is beyond doubt.

The author prepares iodide of bismuth by directing the vapour of iodine upon a heated mixture of sand and bismuth in powder. The crystals are of a beautiful black colour, and of remarkable brilliancy; they are soluble in chlorhydric acid and caustic alkalies (like the iodide M. Schneider prepared with sulphide of bismuth and iodine), but these solvents decompose it. Water, sulphide of carbon, ether, alcohol and amylic alcohol have no action upon it, but they acquire the property of dissolving it when they contain bromide of arsenic, and if iodine be added to such a solution it is immediately decolorised by agitating with bismuth in powder. When heated in an open tube the iodide of bismuth does not fuse like the two others, but is partially decomposed, giving up some of the iodine and forming an orange-red oxyiodide.

Nitric Acid in Natural Binoxide of Manganese.—MM. Deville and Debray[2] have occupied themselves in studying the composition of natural binoxide of manganese, and the gases evolved when it is heated; and they find both to be very complex substances. Scheele discovered that nitrogen was obtained with oxygen, and that the former gas was given off at the commencement of the operation. Berzelius also observed that oxygen obtained from manganese had a slightly nitrous odour. The authors noticed the same smell, but attributed it to the presence of ozone. As they found, however, that their oxygen was always contaminated with some nitrogen at whatever stage of the process it was collected, they were induced to examine the manganese to see what it was that furnished the nitrogen. They first of all distilled off the moisture from some Giessen binoxide, and found the water condensed to be sensibly acid. They saturated this with potash and found they had obtained nitrate of potash and chloride of potassium. By boiling with carbonate of potash, adding to the filtered liquor a slight excess of acetic acid, evaporating to dryness, and treating the saline residue with boiling alcohol, they separated nitrate of potash. By digesting the manganese with distilled water they extracted the following soluble salts:—Sulphate of lime, chloride of calcium, chloride of magnesium, chloride of sodium, nitrate of soda, and nitrate of potash. To account for the presence of the nitric acid, the authors speculate on the possibility of the natural binoxide being formed by the decomposition of the nitrate of manganese. This paper contains only the first instalment of the facts observed by the authors.

M. Boussingault has also noticed the presence of nitric acid in the binoxide of manganese, but has never found it in so large a proportion as MM. Deville and Debray. He does not believe in the derivation of the binoxide from the nitrate, but thinks the binoxide must have been in contact with water containing nitrates or nitric acid. The last-named he believes to be as generally diffused in nature as ammonia; he has found it in gypsum, clays, and marl.

Preparation of Sulphate of Manganese free from Iron.—H. Dellfs[3] points out that when sulphurous acid gas is passed into a mixture of peroxide of manganese and water in the preparation of hyposulphate of manganese, the salt formed is always free from iron however ferruginous the peroxide might have been. He suggests therefore that a sulphate perfectly free from iron may be procured by calcining the hyposulphate obtained as above.

II. ORGANIC CHEMISTRY.

Hydrocyanic Acid and Sulphuretted Hydrogen in Tobacco Smoke.—According to Vogel and Reischaner[4] prussic acid and sulphuretted hydrogen are generally to be found in tobacco smoke. Except in one instance, they discovered prussic acid in all the samples of tobacco they experimented upon. To detect it, they passed the smoke into

[1] *Comptes-Rendus*, t. l. p. 872.

[2] *Ibid.* p. 868.

[3] *Polytech. Notizblatt*, 1860, p. 110.

[4] *Moniteur Scientifique*, No. 81, p. 689.

a strong solution of potash, and then made use of the ordinary iron test. The sulphuretted hydrogen they discovered by exposing to the action of the smoke paper moistened with acetate of lead, or nitroprusside of sodium and ammonia, on which they obtained the characteristic reactions.

Uncrystallisable Atropine.—When rough atropine dissolved in acidulated water is precipitated by an alkaline carbonate, the first matter which falls is resinous, soft, almost liquid, will not crystallise, and prevents moreover the crystallisation of the remainder. By adding the carbonate slowly and noticing when the precipitate has a pulverulent appearance, then decanting the solution and finishing the precipitation in another vessel, the crystallisable atropine is easily separated. The uncrystallisable matter has been found to have alkaline properties, and has received the distinctive name of *belladonnine*.[5]

Preparation of Nicotine.—M. Debize[6] prepares nicotine by placing a mixture of lime and powdered tobacco in a cylinder and passing through it a current of heated steam. The opposite end of the cylinder to that at which the steam enters is connected with a worm which condenses the steam and the products carried along with it, nicotine, ammonia, and some undefined bases. In order to separate the nicotine the liquid is neutralised with sulphuric acid and then concentrated by evaporation. When sufficiently concentrated it is treated with ammonia and ether, by which means an etherial solution of nicotine is obtained which can be easily separated and the nicotine purified by rectification.

III. CHEMICAL ANALYSIS.

Estimation of Chlorine and Sulphur in Caoutchouc.—In order to estimate chlorine and sulphur in organic matters, chemists usually ignite the organic matter with nitrate of potash. This method has been employed for the analysis of india-rubber; but it has been objected that the process is not sufficiently exact for the determination of a minimum amount of sulphur and chlorine, and affords no means of estimating how much of these bodies exists naturally in the caoutchouc, and how much may have been added to produce vulcanisation. To obviate this last objection some one has proposed a method which enables us, according to its author, to distinguish between the chlorine and sulphur existing in a saline state in the natural caoutchouc, and the same bodies in an *elementary* state. The process consists in distilling the caoutchouc below 350° C., passing the volatile products through a red-hot tube, and seeking the hydrochloric acid in the water employed to condense it. MM. Cloez and Gerard[7] object to this latter process, and assert that all the specimens of natural caoutchouc they have experimented with disengage sulphuretted hydrogen and chlorine at a temperature about 250° C.; it would therefore be incorrect to infer that, because a specimen of a manufactured product yielded chlorine and sulphur compounds on distillation, it had been vulcanised by means of chloride of sulphur. It would be necessary first to be assured that the specimen presented all the characters of vulcanisation, and then to determine by comparison the proportions of sulphur and chlorine which existed in the natural caoutchouc and that which had been manufactured. The sulphur obtained on distillation they conjecture is derived from the nitrogenous matters contained in the caoutchouc, which for the most part, like albumen, contain sulphur among their elements; and the chlorine is yielded by chloride of magnesium, which at a but slightly elevated temperature is decomposed into magnesia and hydrochloric acid.

LABORATORY MEMORANDA.

Silvering Glass and Porcelain.—Sir,—In making various experiments the other day with nitrate of silver, I happened to add to a small quantity of a strong solution of that compound an equally small quantity of a thick alcoholic solution of tannin. The quantity, though small, was exposed with a comparatively large surface to the atmosphere by making use of a flat-bottomed evaporating dish.

About an hour afterwards I happened to direct my attention to this dish, and found to my great surprise that the surface in the dish was coated with a thin, brilliant, uniform layer of metallic silver. I directly repeated the experiment and met with the same result again and again. I next proceeded to evaporate the liquid to dryness by placing the dish on the surface of warm sand. As soon as it was completely dry, the coating was found to be so fast on the porcelain that it required the point of a sharp penknife to scrape it off.

From these experiments I would venture to conclude that porcelain, and any other stony and smooth surface, might be plated with silver, and if so it might be useful in many of the arts.

I would add in conclusion that I also succeeded in producing a metallic brilliant coating from a saturated solution of sulphate of copper by the same solution of tannin. May I ask of you the favour of granting these lines a space in your valuable columns, so as to induce practical chemists and others further to investigate the subject.—*Edward R. H. Unger.*

[5] *Moniteur Scientifique*, No. 8, p. 691. [6] *Ibid.* 691.
[7] *Comptes-Rendus*, t. l. p. 874.

MISCELLANEOUS.

Permanganate of Potash.—There is an oxidising agent that at one time was known among chemists and others as the "chameleon mineral," from its rapid changes in colour when dissolved in water, appearing first of a green hue, then a purple, and subsequently a beautiful red, according to the various degrees of oxidation. This "chameleon mineral" is the commercial permanganate and manganates of potash and soda. It is used in deodorising, and occasionally for medicinal and other purposes. Its chief use is, however, as an oxidising agent, its extreme delicacy of operation in this particular rendering it an important agent in the hands of the analytical as well as the manufacturing chemist. Until very recently, however, it could not be manufactured in quantities large enough, and at the price necessary to obtain for it an extended and profitable sale. A short time since Mr. Wildsmith, analytical chemist, of Wolverhampton, having occasion to make a quantity of permanganate, determined to see whether it could not be produced in the quantities and at the price requisite to secure it an extensive market. The experiments which followed were attended with success, and now a ton of either of the manganates of potash or soda can be manufactured where before not more than a few pounds weight could be produced without great cost and labour. The result is that permanganate can now be sent into the market in large quantities at 150 per cent. below its former rate; thus supplying to the toxicologist, the chemist, the manufacturer, and the sanitary commissioner, one of the most important substances within the field of chemical science at a price the same as that at which bichromate of potash is sold. The one now possesses the same commercial value as the other, with the advantage on the side of the permanganate that its action is more rapid than that of bichromate, its oxidising efficacy commencing even at ordinary temperatures.—*Engineer.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Chrysalis.—The presence of cotton in a woollen fabric may be easily recognised by the following tests. When boiled for twenty minutes in a solution of nitrate of mercury the woollen fibres acquire a red colour but the cotton fibres remain colourless. When the fabric is boiled with caustic soda solution (sp. gr. 105) the wool dissolves but the cotton is only slightly affected. Picric acid also stains wool yellow but has no action on cotton.

A Subscriber.—The laboratory course can be entered upon at any time, but it might be to the advantage of our correspondent if he began in October and attended a course of lectures concurrently.

W. P.—We believe not, but you will get certain information from the secretary to the society.

James.—A precipitate does fall after some hours, when the solutions are tolerably strong and perfectly cold.

Provident.—1. We have not forgotten the subject, and shall return to it soon. 2. We did not receive any notice of the proceedings.

Xyliodine.—The nitric acid must be the strongest made, sp. gr. 1·5.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E. C.

THE CHEMICAL NEWS.

VOL. I. No. 26. — June 2, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Detection of Chromium in Presence of Iron, by F. H. STORER.

(*Concluded from page 266.*)

SEVERAL experiments have also been made in order to ascertain whether the presence of peroxide of iron would interfere with the oxidation of the sesquioxide of chromium. Weighed portions of protosulphate of iron were boiled with nitric acid in order to oxidise the iron, and mixed with weighed portions of chrome alum; the solutions were then treated with a slight excess of caustic ammonia and boiled. After washing the precipitates formed, they were subjected to the action of oxidising agents.

I have operated upon mixtures composed of—

No. 1.

Grammes.		Grammes.	Per cent.
3·00 $FeOSO_3 + 7aq$ + 1·00 $KOSO_3$; $Cr_2O_3.3SO_3 + 24aq$	=	$FeO_{1\frac{1}{2}}$ 0·8633	or 84·81
	=	Cr_2O_3 0·1556	or 15·19

No. 2.

3·00 $FeOSO_3 + 7aq$ + 0·50 $KOSO_3$; $Cr_2O_3.3SO_3 + 24aq$	=	$FeO_{1\frac{1}{2}}$ 0·8633	or 91·78
	=	Cr_2O_3 0·0773	or 8·22

No. 3.

5·00 $FeOSO^3 + 7aq$ + 0·25 $KOSO_3$; $Cr_2O_3.3SO_3 + 24aq$	=	$FeO_{1\frac{1}{2}}$ 1·4389	or 97·38
	=	Cr_2O_3 0·0387	or 2·62

No. 4.

10·00 $FeOSO_3 + 7aq$ + 0·25 $KOSO_3$; $Cr_2O_3.3SO_3 + 24aq$	=	$FeO_{1\frac{1}{2}}$ 2·8777	or 98·73
	=	Cr_2O_3 0·0387	or 1·27

No 5.

20·00 $FeOSO_3 + 7aq$ + 0·25 $KOSO_3$; $Cr_2O_3.3SO_3 + 24aq$	=	$FeO_{1\frac{1}{2}}$ 5·7554	or 99·33
	=	Cr_2O_3 0·0387	or 0·67

Portions of the precipitate produced by ammonia in each of these solutions were dissolved in chlorhydric acid, and a part of this solution was treated with an excess of cold potash lye of sp. gr. = 1·305; an excess of caustic soda of sp. gr. = 1·07 being added to another portion. After standing in the cold, out of contact with the air, during eighteen hours, the alkaline mixtures were filtered, and the filtrates thoroughly boiled. No precipitate of sesquioxide of chromium was produced in any of them, nor did these filtrates afford any chromic acid when boiled with peroxide of lead.

Other portions of the moist original precipitates were dissolved in chlorhydric acid, and these solutions treated with a slight excess of dilute caustic soda. A small quantity of peroxide of lead was now added to the mixture, and the whole thoroughly boiled during two or three minutes. On filtering, yellow-coloured solutions were obtained in every instance, and on testing these with peroxide of hydrogen the characteristic reaction of chromic acid was very distinct in each.

The oxide of chromium in other portions of all of the original precipitates was also readily oxidised by boiling them with bromine in presence of free alkali, as well as by dissolving them in concentrated nitric acid, and boiling this solution with chlorate of potash. The presence of chromium was, moreover, readily detected in Nos. 1 and 2 by boiling a mixture of precipitate and alkali with peroxide of manganese, or with permanganate of potash; but as these substances are evidently less conveniently applied than the others which I have mentioned, no further experiments were made with them.

It should perhaps be stated that the experiments upon the precipitate from mixture No 5, were made upon portions of it weighing two or three grammes, the entire weight of the moist precipitate being something more than a hundred grammes.

Among the various agents capable of oxidising oxide of chromium when in presence of sesquioxide of iron, it is not at first sight easy to decide which one should be preferred to the others for common use. Bromine in presence of the alkalies appears to be the most powerful of them, but since the acid solution of peroxide of hydrogen, which is used in testing, would react upon any bromide which might have been formed in the alkaline solution, bromine would be liberated, and, by imparting its colour to the ether, would obscure the reaction. A similar objection applies of course to iodine. This difficulty is easily overcome by neutralising the alkali with nitric acid, and boiling for a few minutes to expel the bromine: an objection to this process, however, is the fact that the solution is considerably diluted thereby.

Chlorate of potash, with concentrated nitric acid, is in some respects a very convenient agent: objections to it are, that some of the products of the decomposition of the chlorate which remain in the solution, appear to interfere with the formation of perchromic acid; moreover, if any nitrate of chromium remain unoxidised in the solution, it will impart a bluish purple tint to the aqueous solution of peroxide of hydrogen, which, though insoluble in ether, often interferes very materially with the detection of the colour of perchromic acid, if only traces of the latter are present. This remark applies to any process of oxidation in which nitric acid is employed. Both of these difficulties can generally be avoided by diluting the nitric acid solution with water, and using a quantity of ether somewhat larger than is usually necessary. In any case where hyponitric acid is generated, it dissolves in the ether, and may conceal the blue colour of perchromic acid.

Black oxide of manganese is not only a less energetic oxidising agent than peroxide of lead, but the chromate formed in its presence does not colour the solution so strongly. The latter remark applies also to permanganate of potash, another objection to which is the necessity of destroying its own colour whenever it has been used in excess, before testing for chromic acid.

On the other hand, the reagent of Chancel, peroxide of lead, is capable, as I have shown, of oxidising sesqui-

oxide of chromium, even when in presence of an enormous excess of peroxide of iron. It has none of the disadvantages of the other substances to which allusion has been made, and is especially to be preferred, since the chromate formed in its presence imparts an intense yellow colour to the alkaline solution.

It must be remembered, however that this coloration, although a very delicate, is by no means a *characteristic* test [1], and that the presence of even considerable quantities of chromic acid cannot be detected in the solution by the methods in common use. For example, the yellow coloured filtrate obtained after having boiled a portion of the precipitate from mixture No. 3 (which contained more than 2·5 per cent. of sesquioxide of chromium) with a solution of caustic soda and some peroxide of lead, was slightly acidified with acetic acid, care being taken not to dilute the solution unnecessarily. No precipitate was formed even after the lapse of forty-eight hours; the solution still retained its yellow colour, however, and afforded a fine blue ethereal solution when treated with peroxide of hydrogen. Even in experiment No. 1, the yellow alkaline solution of chromate of lead gave no immediate precipitate when neutralised with acetic acid, nor did any appear until after the lapse of considerable time.

When concentrated alkaline solutions are used in conjunction with the peroxide of lead, it is best to acidify them, before testing with peroxide of hydrogen, since the reaction might otherwise be disturbed. This is not necessary, however, when dilute alkali is used.

The methods of oxidising chromium which have been discussed in this article are of course applicable to a great variety of cases. I have only specially treated of the one in which this oxide is concealed by an excess of peroxide of iron, since an improvement upon the ordinary processes seems to be peculiarly needed in this instance. It will be found, however, that, with the exception of the blowpipe tests, none of the methods for the detection of chromium which are now in use can be compared with the one herein proposed.

An apparent objection to this process is the doubt which suggests itself whether peroxide of hydrogen may not be capable, under some circumstances, of producing perchromic acid when mixed with solutions, not only of chromic acid, but also of simple sesquioxide of chromium. It is indeed somewhat strange that this should not be the case. I have not, however, been able to effect such transformation, although I have made a large number of experiments with solutions and mixtures of the sesquioxide in the mineral acids and in alkalies, under the most varied conditions as regards their temperature and state of concentration. In short, I have seen nothing which militates in the least against the accuracy of the test.

It is true that, when peroxide of barium is itself added to a solution of sesquioxide of chromium in caustic alkali, and the whole is boiled, a certain quantity of chromic acid is obtained. I have not been able to procure any, however, by operating in the cold.

With caustic ammonia and peroxide of barium, the chromium is gradually converted into a violet ammonia-chromium base in the cold. On boiling the original mixture, a quantity of chromate of baryta is formed. But when in solution in acids, sesquioxide of chromium does not appear to be converted into chromic acid by the action of peroxide of barium, either in the cold or when heated.

[1] It is probable that by the use of the prism, as proposed by Gladstone (*Qu. J. Ch. Soc.* x. 79), these coloured solutions might be satisfactorily tested for chromic acid.

On an apparent Perturbation of the Law of Definite Proportions observed in the Compounds of Zinc and Antimony, by Josiah P. Cooke, *Jun. Cambridge, U.S.*

(*Continued from page 290.*)

Specific Gravity.—The specific gravities of all the crystals analysed, as well as that of the zinc and antimony used in the investigation, were taken with the greatest care. The determinations were made with a nicely constructed specific gravity bottle, as this method was found susceptible of greater accuracy than any other, when the temperature was observed with precision. In calculating the specific gravity, the weight of the water was corrected for the temperature, so that the unit is in all cases distilled water at 4° C. A similar correction could not be made for the temperature of the substance, as the coefficients of expansion of the crystals are not known. The results of the determination, all made by myself, are collected in the following table in the column headed "Sp. Gr. by Experiment." In the column headed "Mean Sp. Gr. of Zinc and Antimony" are given the calculated specific gravities of the same crystals, on the supposition that the two metals had undergone no expansion on uniting. The last column was obtained by subtracting the numbers of the former from those of the latter, and therefore shows the relative amount of expansion. On examining the table, it will be found, 1st. That the union of antimony and zinc is accompanied by expansion. 2nd. That the specific gravity of the crystals varies slightly with the composition. 3rd. That the two minimum specific gravities correspond precisely to the composition of $SbZn_2$ and $SbZn_3$, so that the specific gravity increases and the expansion diminishes as you depart on either side from these two centres. 4th. That the specific gravity of $SbZn_3$ is smaller than that of $SbZn_2$. We find then that the specific gravity determinations confirm in general the results of the analysis, pointing out the same two centres of crystallisation :—

Specific Gravities of Crystals formed in the Alloys of Zinc and Antimony.

Composition of the Alloys.		Composition of the Crystals.		Sp. Gr. of Crystals by Experiment.	Mean Sp. Gr. of Zinc and Antimony.	Expansion in Crystallising.
Per ct. of Zn.	Per ct. of Sb.	Per ct. of Zn.	Per ct. of Sb.			
100·00				7·153	7·153	0·000
96·00	4·00			7·069	7·134	0·065
86·20	13·80			6·898	7·086	0·188
76·30	23·70			6·769	7·039	0·270
70·40	29·60	64·20	35·80	6·699	6·982	0·283
66·50	33·50	61·00	39·00	6·628	6·967	0·339
64·50	35·50	58·56	41·44	6·596	6·936	0·340
62·50	37·50	55·53	44·47	6·506	6·941	0·435
60·60	39·40	55·00	45·00	6·440	6·939	0·499
58·60	41·40	50·39	49·61	6·396	6·917	0·521
56·60	43·40	49·95	50·05	6·388	6·915	0·527
48·70	51·30	48·66	51·34	6·404	6·909	0·505
46·70	53·30	46·77	53·23	6·370	6·900	0·524
44·80	55·20	44·26	55·74	6·341	6·888	0·547
42·80	57·20	43·09	56·91	6·327	6·882	0·555
40·00	60·00			6·386	6·867	0·481
35·00	65·00			6·404	6·844	0·440
33·00	67·00	35·37	64·63	6·401	6·845	0·444
29·50	70·50	33·62	66·38	6·384	6·837	0·453
27·50	72·50	33·85	66·15	6·383	6·838	0·455
26·50	73·50	32·08	67·92	6·400	6·829	0·429
26·00	74·00	31·07	68·93	6·418	6·824	0·406
25·50	74·50	30·43	69·57	6·428	6·822	0·394
24·50	75·50	28·76	71·24	6·449	6·813	0·364
22·50	77·50	26·62	73·38	6·453	6·803	0·350
21·50	78·50	24·83	75·17	6·467	6·795	0·328
15·00	85·00			6·524	6·748	0·224
10·00	90·00			6·613	6·725	0·122
5·00	95·00			6·655	6·701	0·046
	100·00			6·677	6·677	0·000

Crystalline Form.—It has already been stated that only two crystalline forms can be obtained from the al-

[1] Alloys not crystallised.

loys of zinc and antimony, that of $Sb\,Zn_3$ and that of $Sb\,Zn_2$. A large number of crystals of $Sb\,Zn_3$ from different alloys, and therefore containing different proportions of zinc, were carefully measured for the purpose of ascertaining whether the angle was at all affected by the variation of composition. Fortunately four different crystallisations afforded excellent crystals, the angles of which could be measured to a minute. The crystals contained respectively 43·15, 44·14, 46·90, and 55·00 per cents. of zinc. Crystals from many of the other alloys were also measured, but on account of the imperfections of their surfaces the angles could not be determined within five or ten minutes.

The faces of the crystals of $Sb\,Zn_2$ are not generally so perfect as those of $Sb\,Zn_3$, nor is their tabular form so well adapted for measurement; moreover, variations in some of the angles have been noticed in crystals from the same crystallisation, amounting even to ten minutes. The angle o on 1, however, appeared to be very constant, for in all cases where it could be accurately measured the same value was obtained. As none of the crystals of $Sb\,Zn_3$, containing an excess of antimony, could be measured with precision, no constant variation of angle could be detected, and on the other hand it could not be proved to be invariable.

Affinity for Oxygen.—The affinity of the crystals of $Sb\,Zn_3$, of different compositions, for oxygen, may be estimated by comparing the amounts of hydrogen gas evolved in a given time on boiling alloys of the same composition with water. The results of such experiments were given in the former memoir in a table, a mere glance at which will discover the two following facts:—

1st. That up to 40 p. c. no great increase in the amount of hydrogen evolved is obtained by increasing the amount of zinc in the alloy.

2nd. That at the alloy containing 42 p. c. of zinc, there is an immense maximum confined at most between two per cent. on either side.

(To be continued.)

TECHNICAL CHEMISTRY.

On the Presence of Nitrates in Guano, by M. Boussingault.[1]

It is my intention to publish shortly a memoir on the guano deposits of the islands and coasts of the Pacific, in which I shall give some details of the investigations I have made on the nature of this manure: at present I shall only draw attention to one point in these analytical results.

The *Huaneras*, as we know, furnish two kinds of products: earthy guano, principally composed of phosphate of lime, and almost destitute of organic matter, and ammoniacal guano, a mixture of phosphates, urates, and salts of ammonia.

There are also two varieties of ammoniacal guano: the white (*huano blanco*), the excrement which the sea birds deposit in the course of one year; and the brown, which has been deposited for ages, and which belongs, perhaps, to the ancient alluvium. Some quotations of Garzilazo from ancient documents, lead us to presume that the Peruvians only made use of the *huano blanco* in their agriculture. Indeed, all the laws enacted by the Incas, had for their especial object the protection of the birds: thus, the killing of the *guanes*, even away from the *Huaneras*, was forbidden under the most severe penalties, and there was a prohibition against landing on the islands when the birds were laying. These show that the continuous production of the *huano blanco* was the concern of the ancient Peruvians, and not the immense accumulations of guano which remained untouched, as if they wished to leave them for the conquerors of the New World.

Ammoniacal guano is without doubt the most active manure with which we are acquainted, inasmuch as it contains phosphoric acid and assimilable nitrogen; it constitutes the most important deposits of the Chincha islands, where at some points the layers reach to the depth of 33 metres.

Earthy guano only contains one of these two fertilising elements, phosphoric acid. Abundant deposits of it are met with on the coasts of Chili. At one period it was brought to Europe as Peruvian, and occasioned for a time some disturbance of the market. At present when analysis decides on the quality of a manure, an earthy guano, the usefulness of which I am far from contesting, has never the value of an ammoniacal guano.

Two years ago I received from the government of Ecuador a large sample of a guano discovered in the Galapagos islands. An analysis made in my laboratory gave in 100 parts:

Phosphate of lime	60·3
Nitrogen	0·7
Sand and clay	19·7

It was an earthy guano rich in phosphate, but almost destitute of nitrogenised substances. As, however, its action on the soil, according to a report addressed to me, was much more favourable than might have been anticipated from the phosphate alone, it occurred to me to look for nitric acid, and I then discovered in nitrates the equivalent of 3 per cent. of nitrate of potash. Now there can be no doubt that 3 parts of nitrate potash with 60 parts of phosphate would have a much more favourable action as a manure than the phosphate of lime alone; and this accounts for the superior qualities noticed in the earthy guano of the Galapagos. I have since met with nitric acid in all the guanos I have been able to examine.

For some time large quantities of an earthy guano have been imported from several islands in the Pacific: Jarvis, Baker, Howland islands, &c.

In a sample from Jarvis Island, M. Barral has found

Phosphate of lime	82·3
Nitrogen	0·3
Sand and clay	0·2

A kilogramme (nearly 2¼ pounds) of a guano said to come from the same place, gave in nitrates the equivalent of 5 grammes (77 grains of nitrate of potash).

An earthy guano from the coast of Chili yielded in 100 parts:

Phosphate of lime	44·0
Nitrogen	0·6
Sand and clay	6·4

and in a kilogramme of this sample we estimated in nitrates the equivalent of 6·33 grammes (97 grains) of nitrate of potash.

In a Chilian guano analysed by M. Girardin, which gave

Phosphate of lime	37·0
Nitrogen	2·1
Sand and clay	15·4

I found the equivalent of 2·34 grammes of nitrate of potash in the kilogramme. Thus the earthy guanos,

[1] *Comptes-Rendus*, t. l. p. 887.

independently of the properties attributable to the phosphate of lime, must also possess those which belong to materials richly nitrated.

Nitric acid also exists in the Peruvian ammoniacal guanos, but in a smaller proportion: the following is the process I have followed for proving the presence of this acid. The guano is digested for 24 hours in the cold with alcohol, sp. gr. ·864. The alcoholic solution is evaporated in a water bath a yellow residue is left; which is dissolved in a little water, and it is then easy to detect the nitrates in the solution by means of sulphuric acid and copper, or the indigo test. To estimate the amount it is only necessary to distil the solution, sufficiently concentrated, with finely powdered and *well washed* binoxide of manganese, and pure sulphuric acid diluted with twice its volume of water. The amount of nitric acid in the liquid distilled may be quickly estimated by tincture of indigo.

The following are the results of the examination of different specimens of ammoniacal guanos:—

1. Peruvian (but suspected to be mixed with earthy Chilian) which contained 5·7 per cent. of nitrogen, gave the equivalent of 4·7 grammes of nitrate of potash in the kilogramme.

2. Guano from the Chincha islands, which had been kept in the air for several years, and had lost all ammoniacal odour: it contained in 100 parts:

Phosphate of lime	27·4
Nitrogen	8·6
Sand and clay	1·2

and gave 1·1 grammes of nitrates in the kilogramme.

3. White Peruvian guano, containing

Phosphate of lime	24·6
Nitrogen	8·1
Sand and clay	2·0

yielded the equivalent of 2·75 grammes of nitrate of potash in the kilogramme.

From the preceding facts we see that in the chemical examination of guanos, especially the earthy variety, it will be necessary in future to look for nitrates. The acid of these salts contains assimilable nitrogen, which is but very imperfectly estimated by the soda lime process usually adopted for the assay of guanos. In conclusion I may remark that the guano from the Galapagos islands, although destitute of organic matter, contains the tribasic phosphate of lime associated with nitrates; and that the good effects of this mixture on vegetation fully justified the views I formerly submitted to the Academy on the association of natural phosphates with Peruvian nitrate of soda to form a manure which should contain the two most important fertilising elements, phosphoric acid and assimilable nitrogen.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS, *Wednesday, 9 May* 1860.

DR. J. FORBES WATSON *On the Chief Fibre-yielding Plants of India.*

THOMAS BAZLEY, *Esq. in the Chair.*

(*Continued from* p 299.)

THE Sunn hemp, so largely cultivated in India and exported to this country under the various names of "brown hemp," "Madras hemp" "Taagor Conkanee hemp," &c., is a product of the *Crotalaria juncea*, a kind of broom. The fibre is harsh, but well adapted for cordage, and its general quality might be greatly improved if greater attention were paid to its culture and preparation. It varies greatly according to the climate. Microscopically, as shown at *a*, Fig. V. the Sunn appears rougher and straighter than hemp, and is without cross-markings.

Our next fibre is yielded by the Dunchee, *Sesbania aculeata*, and is one highly valued for rope-making, as it resists the action of water and chemicals very well; it, however, is said to shrink greatly when wetted. Its microscopic peculiarities are faithfully rendered at *c*, Fig. V., where the comparatively regular diameter of the fibres will be noticed.

The Rajmahal bowstring creeper (*Marsdenia tenacissima*) which furnishes the jetee fibre, is described as a very elegant plant, discovered in 1800, by Mr. W. Roxburgh. The removal of the bark and pulpy portions is a simple task, and one person can clean 6 lbs. of fibre per diem. The microscopic appearance of the jetee is delineated at *b*, Fig. V.

The Lecturer then proceeded to describe the more important characteristics of some of the indigenous fibre-plants commencing with the well known pine-apple. *Ananassa sutida*, whose leaves afford a very fine and beautiful fibre, well adapted for spinning,—in this latter respect dissimilar to most others of the same class. The *Anamassa* may now be called indigenous, and it flourishes alike in Assam, on the Khaisa hills, in the Tenasserim provinces, and in the neighbourhood of Rangoon and Singapore. Its fibres, some samples of which, valued at 50*l.* per ton were exhibited, are of great strength and very divisible, while their lustre is calculated to render the material a very favourite one with the fair sex. Placed upon dark glass, and viewed by reflected light under the 1-inch object-glass, the pine-apple filaments present the appearance shown at *a*, Fig. VI., looking glassy and somewhat opalescent. The fibre is prepared for the market by crushing and scraping the leaves and leaf stalks soon after pulling. Machinery is badly wanted in this department, the Doctor said, and even a cheap hand-crusher would be a boon.

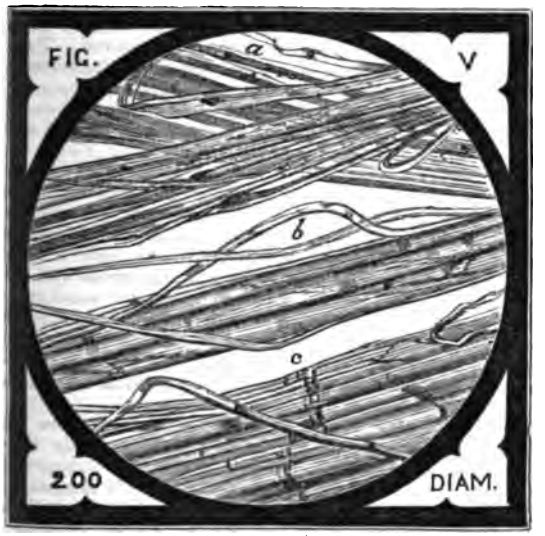
The "*Moorva*," "*Marool*," or "*Murda*" fibre is derived from a liliaceous plant, the *Sanseviera zeylanica*, abundant in Java, Ceylon, and on the coasts of China and Bengal. There are several closely allied species of the *Sanseviera*, perennial, and growing under jungle bushes in almost any soil, to the height of 3 or 4 feet. The natives prepare the fibre by laying a leaf on a board, fastening one end by the great toe, and then scraping *from them* with a thin piece of wood. About 80 lbs. of fresh leaves are required to furnish 1 lb. of clean fibre, according to Roxburgh, giving 1613 lbs. as the yield per acre for each crop, of which two are obtainable annually. The fibre is worth about 40*l.* per ton, seems to be well adapted for fine string, twine, &c., and under the microscope resembles the pine-apple, but is much larger individually, more opaque, and has little or no opalescence.

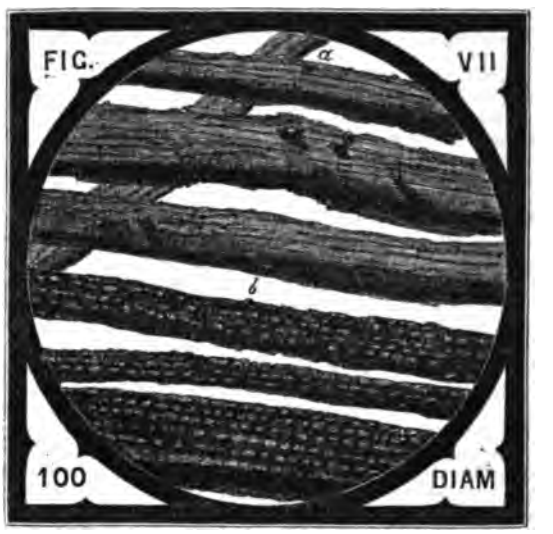
The *Agaves*, often wrongly called aloes, were next brought before us; two species are abundant, and might be cultivated for fibre, viz. the *Agave Americana*, and *A. Vivipara*. The value of this fibre varies with its length, samples exhibited being worth respectively 18*l.*, 28*l.* and 45*l.* per ton. It is now used for imitating horsehair. The ultimate fibres are about three times the size of the pine-apple filaments, and the microscope shows the opalescence to be very marked.

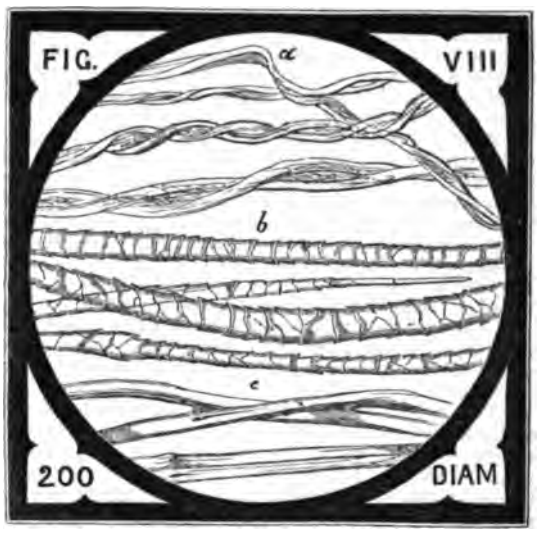
Various species of Adam's needle,—the *Yucca gloriosa* and others, yield fibres of from two to four feet long, and ranging in market value from 24*l.* to 35*l.* per ton. The plantain, *Musa paradisaica*, is cultivated for its fruit, but the leaves furnish from 4 to 6 per cent. of a tolerable fibre, weaker than any preceding in this class, and valued at about 22*l.* per ton. The chief difference in the microscopic appearance of plantain fibre consists in its distinct cross markings. Another *Musa*,—the *M. textilis*, gives the well-known "Manilla hemp" of commerce so useful for cordage and standing rigging. This fibre is light and strong; it is not produced in India, but almost entirely in the Philippine Islands. The Manilla hemp magnified 100 diameters is shown at *c*, Fig. VI. where the whited portions represent the more dense deposits of lignine. For the sake of comparison the Doctor also briefly noticed the so-called *New Zealand flax*, the microscopic appear-

ance of which is somewhat different from the others we have noticed; the fibres are often slightly twisted, and resemble shreds of gelatine. (*b*, Fig. VI.) The leaves of the plant furnish the fibre, which will bear a good longitudinal, but only a slight transverse strain.

Coir, the "*coco-nut*[1] *fibre*" of our shops, we must just name. It is much in demand for mat and brush-making. Under the microscope the fibre of the *Cocos nucifera*, or rather of its fruit, presents a very peculiar and characteristic appearance (represented as far as possible at *a*, Fig. VII.)







which, according to Mr. Wentworth Scott, can only be properly observed by laying the specimen upon a slip of "*opal glass*" (Chemical News, p. 202), through which a strong light is transmitted, while its surface is also illuminated by means of a mirror or condenser. Thus seen, the coir is of a yellowish-pink colour, translucent and coralline, with longitudinal striæ superficially.

The *Pandanus odoratissimus* yields two kinds of fibre from its leaves and roots respectively; the root fibres are very tough, and are much used for scrubbing, &c. The Ejoo or Gomato fibre, otherwise "*vegetable bristles*" exist on the leaf sheaths of the *Arenga saccharifera* as black spines. The tree stem is about twenty or even thirty feet high, and the foliage rises nearly as much more. About three quarters of a pound of fibre may be cut from each leaf of which six are annually produced. The ejoo is stronger than coir, and has a very remarkable appearance under the microscope when placed upon opal glass, and viewed by reflected light. The surface is dotted over with little rugosities arranged in longitudinal lines, and having minute depressions at their summits which are of a lighter colour than the other parts; these appearances are beautifully shown at *b*, Fig. VII.

The last woodcut, Fig. VIII. is introduced in order that our readers may be able to compare the microscopic appearances of the various fibres before described with that of cotton, wool, and silk. At *a*, Fig. VIII. a specimen of New Orleans cotton (*Gossypium*) is shown; some Australian wool lies immediately beneath it (at *b*), the peculiar imbricated ap-

[1] Often improperly written "cocoa-nut."—Ed.

pearance of which will be readily observed, while at *c*, the dual filaments of silk, spun by that industrious insect, the *Bombyx mori*, are well represented.

Dr. Watson terminated his long list of fibres with the names of a "vegetable horse-hair" of Sind called "*Pfees*," (*the Chamaerops Ritchiana*) and a grass from the same region denominated "*Moong*." The latter is much used for drag-ropes on the Indus.

On the subject of paper-making, the remarks of our author were so concise, interesting and just, that we quote them in full:—

"Having now reviewed, however briefly and imperfectly, some of the facts connected with the fibres which I have ventured more or less to recommend to your attention, I would wish to refer to the subject of materials for the paper manufacture. It cannot have passed unobserved that I have but once mentioned the name of paper in enumerating the various useful applications of fibres. But the question of the supply of raw materials — apart from the difficulties in the way of converting them into suitable pulp, is entirely one of the cost of production of the half-stuff from which the paper is eventually elaborated. True it is that the vast majority of plants contain fibres, and that these are available for certain purposes; but all fibres are not of equal value. The tenacity of those furnished by the Exogens, as a rule, far exceeds that from the Endogens. And the innate quality to resist strain, depends entirely upon the strength and toughness of the fibre. Thus, I find that a Bank of England note, which is, I believe, chiefly manufactured from clean unmixed linen rags, will sustain a weight of 35 lbs., but a similar sheet of paper, made from the Rheea, precisely the same in every respect, will carry a weight of nearly 60 lbs. These results, for which I am indebted to Mr. Wyndham Portal, prove the difference in the relative strength of the Rheea as compared with flax to be nearly as two to one.

"Nevertheless, we are all agreed about the suitability of linen for paper, and it may not be amiss to say a word on the great 'rag question.' The definition of a rag I take to be this: the perfection in the arrangement of a raw fibre for the production, under mechanical operations, of a paper pulp of uniform density. The best fibres are, of course, employed in the loom, but cotton rags of any description are superior to the sweepings of a cotton-mill.

"With a due appreciation of the importance of rags, I doubt whether the supply will meet the demand for half paper stuff. For the manufacture of paper, in the sense in which that substance used to be understood, from linen and cotton rags, if a proper system of collecting them were established, there would be abundance, and I firmly believe that, for the mere inculcation of thrifty habits in domestic matters, it would be very important to advocate their careful preservation. But when it becomes a question of such an extension of manufacture as is likely to result in consequence of the repeal of the paper duty — from match boxes to omnibuses — then indeed it is high time to inquire what we are to substitute.

"That there is no lack of materials may be gathered from the variety of substances which have been proposed as substitutes. I find that no less than 120 have been recommended, and a fair proportion of these have formed subjects for special patents. Some of them form excellent pulp, but are practically useless, because of insufficient supply. Others are so defective as to fibre, that the resulting paper is incapable of resisting strain; whilst perfectly suited for giving body to the paper, they require the admixture of a more tenacious material. In the latter category we must place straw and other stems which contain at best but a small proportion of indifferent fibre, and whose apparent strength is owing rather to silica than to fibre. Although we fully admit the possibility of removing the great body of the silica by chemical agents, yet do we injure the strength of the paper almost in the same proportion. Certain it is that those newspapers which are printed on straw paper still contain a considerable quantity of silica. Comparing a straw paper with one made from rags, Dr. Bernays found: —

	Ash.
In the *Morning Star*	4·15 per cent.
In the *Times*	0·88 " "
And of silica: —	
In the *Morning Star*	1·460 " "
In the *Times*	0·145 " "

"Now my object is not to depreciate straw paper. I admit its full value, and believe it of extensive applicability. But in many cases I cannot but think that it would pay better to substitute a more promising material than to use a very inferior one of which larger bulk is required. Thus, the strength of the rheea is so great that it might, perhaps, be used with advantage in small quantities to supply the defectiveness of materials partaking of the characteristics of straw. In practice, this is already acknowledged, and it is only for principles that we are contending, for almost all paper consists of rags with varying proportions of raw fibres. Possibly, then, some of our best and strongest Indian fibres may be employed to give tenacity, but it is improbable that any could be imported specially for the paper manufacture, as those which would have to compete with rags would not be of sufficient strength to compete with the articles to be had nearer home. If suitable machinery could be established in India, so as to turn to better account her boundless resources, then her superior class of fibres might probably be obtained at a cheaper rate; but the proposal to introduce the domestic manufacture of half-stuff into India is not likely to take root for many reasons."

The paper concluded with some observations upon the commercial statistics of the chief fibres previously considered, and the Doctor referred to the various tables and diagrams suspended on the walls to support his arguments. To indicate more clearly to the mind the relative quantities of material produced in or imported by various countries, coloured squares were shown on the diagrams, in addition to the actual figures, thus enabling a general idea of the leading facts to be acquired at a glance. In this way the immense proportional quantity of cotton exported by America compared with the total amount produced, stood out in bold relief, as also did our English imports of that fibre alongside the square representing the quantity taken by all other nations combined, and so on with varying results with the other fibres. The steady development of the general resources and productions of our Indian empire was readily exhibited in a similar manner.

The paper was illustrated by a large collection of fibres and fabrics, lent for the occasion by the Secretary of State for India, and by specimens to elucidate various processes for cleaning and preparing the various fibres. A number of microscopic preparations were also on the table, and Mr. Baker of Holborn exhibited several microscopes with which their chief features could be conveniently observed by the members.

The more pleasing portion of our task is now accomplished, for while we sincerely congratulate Dr. Forbes Watson upon his varied and extended labours, and on the still more extended and important results to which they must inevitably lead, we cannot help designating the discussion which followed the reading of his paper as poor, trivial, and wholly unworthy of it and of the Society. After the general invitation of the Chairman, the first to rise was a certain Mr. Wilkins, who in a broad provincial accent delivered a ludicrous and wholly irrelevant speech relating to some method of growing peas,—beans,—mangold-wurzel—bread made four years ago, "und az sweeut az a turnip yet" — the Duke of Wellington — a covetous old lady in Berkshire, &c. (!) while he held up various specimens of seeds, pieces of bread, red tile, &c. derived from a capacious hat-box at his feet. The entire meeting was convulsed with laughter, and it was not until nearly a quarter of an hour of valuable time had been thus wasted that the refractory orator took his seat amid loud cries of "order" and "chair."

In the lengthy communication of Mr. P. L. Simmonds which followed, we looked in vain for an original observation worth transcribing.

Mr. Thomas Routledge confined his remarks to the subject of the manufacture of paper from raw fibre; his speech was a sound and practical one, and we regret that space is too limited to allow of its repetition here.

Mr. Warren described and showed the action of Burke's machine for cleaning fibres.

Colonel Sykes thought they had not been doing justice to the author of the paper, and referred in an able manner to the matter under consideration. Various other speakers followed, but throughout the discussion the great tendency exhibited was that of indulging too greatly in family histories and domestic details, in lieu of affording valuable information or legitimate criticism.

A cordial vote of thanks was awarded to the author of the paper we have thus imperfectly considered.

SOCIETY OF ARTS, *Wednesday*, 16 *May* 1860.

R. Temple, *Esq. in the Chair.*

The paper read was *On the Art of Perfumery, its History, and Commercial Development*, by Eugène Rimmel. Perfumery the author defined as the art of collecting and presenting in a convenient and fixed form, for the gratification of the sense of smell, the numerous volatile and evanescent fragrant principles diffused throughout nature. Perfumes are invisible and imponderable emanations from all odoriferous bodies carried through the atmospheric air, and rendered perceptible to our senses by means of our olfactory organs. They can become fixed in other bodies with which they come in contact, and on the degree of affinity which exists between them may be said to rest the principles of the art of perfumery. Animal substances are found to absorb odours more readily than any others; vegetable substances possess that property to a less extent, whilst metallic bodies entirely repel them. The odoriferous particles are of such tenuity that no perceptible difference in weight can be observed in bodies which emit them unceasingly. A single pod of musk was found to have discharged in one day 57,000,000 particles in a radius of 30 yards, without having become in any way diminished. Other very abstruse calculations have been made to determine the exact size of an odoriferous particle, but the results obtained by the various learned men who have made these experiments so totally differ from each other, that it is permitted to doubt their accuracy. The author went on to notice the reputed physiological effects of perfumes, and in illustration of the supposed prophylactic properties of scents, observed that when London and Paris were ravaged with cholera there was not, *to his knowledge*, a single victim among the numerous hands employed in the perfumery factories of either city. "Odours," he continued, "have been classified in various ways by scientific men. Linnæus divided them into seven classes, three of which only were pleasant odours, viz.—the aromatic, the fragrant, and the ambrosial; but however good his general divisions may have been, the above were far from correct, for he classed carnation with laurel leaves, and saffron with jasmine, than which nothing can be more dissimilar. Fourcroy divided them into five series, and De Haller into three. All these were, however, more theoretical than practical, and none classified odours by their resemblance to each other. I have attempted to make a classification comprising only the various odours used in perfumery, by adopting the principle that as there are primary colours from which all secondary shades are composed, there are also primary odours with perfect types, and that all other aromas are connected more or less with them, and can be obtained by the combinations of those primary odours:—

Classification of Odours.

Classes.	Types.	Odours belonging to the same Class.
Rose	Rose	Geranium, Sweetbriar, Rhodium, Rosewood.
Jasmine	Jasmine	Lily of the Valley.
Orange Flower	Orange Flower	Acacia, Syringa, Orange leaves.
Tuberose	Tuberose	Lily, Jonquil, Narcissus, Hyacinth.
Violet	Violet	Cassie, Orris-root, Mignonette.
Balsamic	Vanilla	Balsam of Peru and Tolu, Benzoin, Styrax, Tonquin Beans, Frankincense, Heliotrope.
Spice	Cinnamon	Cassia, Nutmeg, Mace, Pimento.
Clove	Clove	Carnation, Clove Pink.
Camphor	Camphor	Rosemary, Patchouly.
Sandal	Sandalwood	Vetivert, Cedarwood.
Citrine	Lemon	Bergamot, Orange, Cedrat, Limette.
Lavender	Lavender	Spike, Thyme, Serpolet, Marjoram.
Mint	Peppermint	Spearmint, Balm, Rue, Sage.
Aniseed	Aniseed	Badiane, Carraway, Dill, Coriander.
Almond	Bitter Almonds	Laurel, Peach Kernels, Mirbane.
Musk	Musk	Civet, Musk-seed, Musk-plant.
Amber	Ambergris	Oak-moss.
Fruit	Pear	Apple, Pine-apple, Quince.

A very interesting sketch of the history of perfumery followed, but for this we have no space. Nor have we room for the statistics of the perfumery trade in London and Paris.

"The principal branches of the perfumery trade are making scented soaps, compounding perfumes, and preparing various articles used for the toilet. The process of soap-making is so well known to you that I need not describe it here; I shall only mention that there are four kinds of soaps generally manufactured by perfumers, hard soap by the hot process, which is made by boiling grease, and sometimes a small portion of resin, with an excess of soda lees, until they become saponified; hard soap by the cold process, which is prepared by introducing a fixed dose of concentrated soda lees into grease in a liquefied state; soft soap by the cold process, which is obtained in the same way as the last, only substituting potash for soda lees; and transparent soap, which is a combination of soap and alcohol. The cold process is principally resorted to when a delicate colour or fine odour is to be procured. By substituting a pomade for the grease you obtain the true scent of the flower.

"The next important branch of the trade is the preparation of perfumes, of which large quantities are consumed both at home and abroad. The basis of all fine perfumes is obtained by treating with alcohol the pomade or oil extracted from the flowers, as I shall explain hereafter. This may be called the truly artistic part of perfumery, for with a very limited number of flowers the perfumer has to imitate all the others. This is done by studying resemblances and affinities, and blending the shades of scent as a painter does the colours on his palette. Thus, for instance, no perfume is extracted from the heliotrope, but as it has a strong vanilla flavour, by using the latter as a basis with other ingredients to give it a freshness, a very perfect imitation of that flower is obtained, and so on with the others. There is also a large quantity of toilet waters manufactured chiefly with an alcoholic basis. The most widely known is the Cologne water, which was invented in the last century by an apothecary in Cologne. It can, however, be made just as well anywhere else, as all the materials for it come from the south of France. Its perfume consists principally of the flowers, leaves, and rind of the fruit of the bitter orange-tree, which blend well together, and form an harmonious compound. The toilet vinegar is a sort of improvement on Eau-de-Cologne, with the addition of balsams and vinegar. Lavender water was formerly distilled with alcohol from fresh flowers, but is now prepared by digesting the essential oil in alcohol, which produces the same result at much less cost.

"The ingredients used for making up perfumery are very numerous, and come from all parts of the world. Time will not allow me to read the list through, but I shall give you a brief summary of those materials, grouping them together according to their nature, in the following twelve series:—

"1. The animal series, comprising musk, civet, and am-

bergris. It is very useful in perfumery, on account of its durable aroma, which resists evaporation longer than any other. Musk is a secretion found in a pocket under the belly of the musk deer, a ruminating quadruped, inhabiting principally the mountains of Thibet, Tonquin, and China. The best is called Tonquin musk, the next in quality is the Assam musk, and the most inferior is the Caberdeen musk, which comes from Siberia. Civet is the secretion of the civet cat, an animal found in the Indian Archipelago and in some parts of Africa. It has a most repulsive odour by itself, but combined in small quantities with other perfumes it produces a pleasing effect. Ambergris is a curious substance which for a long time puzzled the savans, but is now acknowledged beyond a doubt to be a morbid secretion of the sperm whale. When the animal is thus diseased it ejects the ambergris, which is found floating on the sea, or more frequently deposited on the coast. I have a very curious specimen, which was found inside a whale before the disease had come to its maturity, and is of a black colour. Ambergris, although apparently possessed of little scent, imparts a most ethereal and delicate odour to other perfumes.

"2. The floral series includes the following, which have hitherto been the only flowers available for perfumery purposes:—Jasmine, rose, orange-flower, cassie, tuberose, violet, jonquil, and narcissus. Out of those eight, four only yield an essential oil by distillation, viz. the rose, orange-flower, jasmine, and cassie. The essence or otto of roses comes principally to this market from Turkey, where the flower is largely cultivated in the neighbourhood of Adrianople. The competition in price, however, causes it to be very seldom pure, being more or less adulterated with an oil called Turkish geranium, which is in reality nothing but Indian ginger grass oil. The usual market price of Turkish otto varies from 15*s.* to 30*s.* per oz. according to its degree of purity. The otto made in the south of France is very fine, but not so rich in flavour as the Tunisian otto, which is worth 4*l.* per oz. If, however, we are to judge quality by price, the palm must be awarded to the East India otto, made at Ghazepore, which costs there 12*l.* per oz. The essence of orange-flower, called neroli, is of two sorts. The best is made from the flowers of the bigarrade, or bitter orange-tree. The flower of the edible orange-tree, commonly called Portugal, yields a very inferior essence. The two other essential oils, jasmine and cassie, are only distilled in Algeria and Tunis, and their high price precludes their being used to any extent. The most ordinary way of extracting the aroma of flowers is by means of fatty bodies through a process which I shall describe hereafter.

"3. The herbal series, distilled from the flowers, leaves, or stalks of plants or shrubs, and comprising principally geranium, lavender, peppermint, fennel, thyme, marjoram, serpolet, spike, rosemary, verbena, petit grain, made from the leaves of the orange-tree, patchouly, and wintergreen.

"4. The andropogon series, which comes all from the island of Ceylon, and consists of the *Andropogon schœnanthus*, or lemon-grass, which is used to imitate verbena, which it closely resembles. The *Andropogon citratum*, or citronella, used principally for scenting honey soap, and an undefined species, which yields the ginger grass oil of commerce. This is a very useful series, and the two former especially are grown to a considerable extent in the island of Ceylon.

"5. The citrine series, comprising the bergamot, orange, lemon, cedrat, and limette, all belonging to the citrus family. The rind of the fruit only is used, and yields an essential oil by expression or distillation — the former is by far the best. On the coast of Genoa it is prepared by rubbing the fruit against a grated funnel; in Calabria, by squeezing out the oil on a glass surface; and in Sicily, by pressing gently the pared rind in cloth bags.

"6. The spice series, including cassia, cinnamon, cinnamon-leaf, cloves, mace, nutmeg, and pimento.

"7. The wood series, consisting of sandal-wood, rose-wood, rhodium, cedar-wood, and sassafras.

"8. The root series, comprising oris-root and vetivert. The vetivert, or *Anatherum muricatum* called by the Hindoos Kus-kus, is extensively used in India for making mats and blinds, which being frequently watered in the sun, shed a most pleasant fragrance. It gives a very lasting perfume.

"9. The seed series, composed of aniseed, dill, and carraway.

"10. The balm and gum series, including balsam of Peru, balsam of Tolu, benzoin, styrax, myrrh, and camphor. With the exception of the last, they are all exudations of various trees. Camphor is obtained by boiling the wood of the *Laurus camphora*.

"11. The fruit series, including bitter almonds, tonquin-beans, and vanilla. The essential oil of bitter almonds contains from eight to ten per cent. of prussic acid, which can be removed by distilling it over potash. Vanilla is the fruit or bean of a creeper found principally in Mexico.

"12. The artificial series, comprising all the artificial flavours produced by chemical combinations. Of these the most extensively used in perfumery is the nitro-benzine, usually called mirbane, or artificial essence of almonds. This is obtained by treating rectified naphtha with nitric acid alone. The naphtha is poured slowly through a tube into the acids, decomposition follows, and the essence is found floating on the surface. Artificial essences of lemon and cinnamon have also been produced, but have not been brought to sufficient perfection to be available for practical use. Besides these, artificial essences, imitating fruit flavours, are manufactured, but principally for making confectionery. The pear essence is an amylic ether, the apple essence a valerianic ether, containing amyl, and the pine-apple essence a butyric ether. The whole of those require diluting with five or six times their weight of alcohol to develop their flavour.

"In the above I have not compromised the inodorous materials used for perfumery as bases, such as spirits of wine, oil, &c., as they are also applied to other purposes. I shall only allude to four oils which might perhaps be employed for perfumery, and of which I exhibit specimens. The oil of ben, produced on a large scale in Jamaica, by Mr. Kemble, which has the advantage of not becoming rancid; crab-oil or carapa-oil, from Demerara, which can be obtained also from the west coast of Africa; gingelly or sesamum oil, from India, used by the Hindoos for toilet purposes; and oil of tamanu, from Otaheite, which is yielded by a sort of wild almond.

"There are now two processes in use for making scented pomades and oils, one is by maceration, and the other by absorption. The former is used for the less delicate flowers, such as the rose, cassia, orange flower, jonquil, and violet, which can bear a tolerable degree of heat without losing their scent. A certain quantity of grease is placed in a pan fitted with a water bath and brought to an oily consistency. Flowers are then thrown in and left to digest for some hours, after which they are removed and others are put in, and so on for two or three days, until the grease is quite saturated. It is then taken out and pressed in cloth bags. The process of absorption, called by the French enfleurage, is chiefly confined to the jasmin and tuberose flowers, but is sometimes applied to the cassie. It consists of a series of square glass frames, covered with a thin layer of purified grease, in which ridges are made to facilitate absorption. Fresh gathered flowers are strewed on that layer, and renewed every morning as long as the flower is in bloom, and by that time the grease has acquired a very strong flavour. The same process is used for oil, but the frames instead of a glass have a wire bottom, over which is spread a thick cotton cloth soaked in olive oil. Flowers are laid on in the same way, and the cloths submitted to a strong pressure to extract the oil when sufficiently impregnated. The frames are piled up on each other to keep them air-tight.

"The three principal towns where this manufacture is carried on are Grasse, Cannes, and Nice. From the details furnished by M. Pilar, one of the first manufacturers of Grasse, it appears that there are about 100 houses engaged

in that occupation, and in that of distilling essential oil, materials for which abound in the neighbourhood. Out of that number 70 are in Grasse, which may be called the head-quarters of the trade. The following are approximate numbers and values of the flowers consumed in that locality for manufacturing purposes: —

800,000 kilos.	or 1,760,000 lbs.	of	Orange Flowers, worth about	£32 000
250,000 "	550,000 "	"	Rose Flowers "	10,000
50,000 "	110,000 "	"	Jasmine Flowers "	6,000
30,000 "	66,000 "	"	Violets "	7,000
30 000 "	66 000 "	"	Cassia "	10 000
15,000 "	33,000 "	"	Tuberose "	3,000

"The average quantities of the principal articles manufactured are: —

300,000 kilos.	or 660,000 lbs.	of scented pomades and oil, worth about		£250,000
80 000 "	176,000 "	Rose Water "	"	5 000
500.000 "	1.100,000 "	Orange Flower water,	1st qty.	30.000
1,000 000 "	2,200,000 "	" "	2nd "	50.000

"This does not include the essential oils, of which the list would be too long, but some of them are very valuable, such as the Neroli, for instance, which is distilled from orange flowers, and is worth about 10*l.* per lb.

"The processes I have described are those in actual and practical use; but there is a new process, lately patented by M. Piver, the eminent Paris perfumer, to extract the aroma of flowers by the pneumatic principle, which is extremely ingenious. I shall describe it to you, M. Piver having kindly allowed me to inspect it. A strong current of air is forced, by means of an air-pump, into a receiver filled with fresh flowers, and passes into a cylinder containing grease in a liquefied state, which is kept in constant motion, by a series of discs revolving on an axis in the centre. The fragrant particles come thus in contact with a surface of grease, constantly renewed, which readily absorbs the greater part of them, and passing through a second cylinder fitted in the same way, those that have escaped the first become fixed in the second, and let the air issue nearly scentless. In order to avoid all chance of waste, the same current of air is driven several times again through the flowers in the same way, until it has exhausted all their scent. The force of this current of air is such that although the flowers are put in perfectly dry, it drives out of them part of the water, which they naturally contain, and which is collected in a receiver at the side of the apparatus. This water, which is quite a new product, possesses the scent of the flower in the highest and most refined degree. I have here specimens of the scented oil, and of the water produced by this process. This apparatus not having come into practical use yet, it would be somewhat premature to discuss its merits in a commercial point of view, but as it performs in twenty-four hours a work which usually takes as many days, and as, moreover, it absorbs all the aroma of the flowers without wasting a particle, it appears to me to be likely to become generally adopted, if the cost of working is not too great. There is, however, a disadvantage connected with it; the pomades and oil produced by that means become rancid in a very short time, owing, no doubt, to the quantity of oxygen which they absorb in the rapid motion which they undergo in the cylinder; if this cannot be remedied, these pomades will only serve for infusing in alcohol, and will have to be employed as soon as they are made.

"Another new and interesting process is that patented by M. Millon, a French chemist, for extracting the aroma of flowers by means of ether, or sulphuret of carbon, which are both powerful solvents. M. Millon operates in this way:—The flowers are placed in a percolating apparatus, and the ether or sulphuret of carbon poured over them; after leaving them in contact for ten or fifteen minutes the liquid is drawn off, and a fresh quantity added, and drawn off in the same way. This completely dissolves all the odour of the flowers, and leaves them quite scentless. The liquid is then distilled, and the ether or sulphuret of carbon becoming volatilised at a much lower temperature than the fragrant principle is drawn over alone, and leaves a residue containing all the perfume of the flower. This residue is sometimes quite solid, and sometimes semi-liquid, but it always becomes solid in a short time. It is spread in thin layers, and exposed to the heat of the sun, or some equivalent temperature, until it loses the unpleasant smell of the solvent used. It can be left open for any length of time without evaporating, nor is any degree of natural heat capable of altering the perfume or turning it rancid. It has a much finer flavour than any sort of essential oil, as you can see by the specimen on the table, which M. Millon explains by stating that the perfume of a flower always became altered by being subjected to a higher temperature than that of the atmosphere. If this residue is treated with alcohol it takes up the odour and colouring matter, and a small portion only of the resinous and waxy matters forming the residue. This alcoholate again, treated with distilled water gives up the greatest part of the aroma. Plain water, however, has no effect on it. The residue is also soluble in grease or oil. This process is very curious in a scientific point of view, as it is the nearest approach that has been made yet to the insulation of perfume from the substances into which it is usually embodied. It is far from being, however, the actual fragrant principle in a solid and palpable shape, nor has Mr. Millon been able to ascertain exactly what proportion it bears to the flowers used. The residue he obtains averages from one to three grammes per kilogramme (or one to three per 1,000) and when it has been treated with alcohol, and given up all its perfume and colouring matter, the inodorous waxy substance left seems to have lost scarcely a few hundred parts of its weight. M. Millon tried to insulate the aroma from alcohol by distillation, but it became lost in the operation, and on his trying to evaporate it with distilled water the water became perfumed, but without leaving the fragrant principle floating on the surface, as is generally the case. He found it therefore, theoretically and practically impossible to solve that interesting question. This process has not yet received any application on a large scale. I think it, however, very important, if it can be worked at a moderate price, not for great centres of manufacture, where other and cheaper means can be adopted, but to collect the perfumes of flowers in places where sufficient quantities do not exist to warrant the expense of a regular manufactory, and where it may be convenient to use a light and portable apparatus such as this is."

In the conclusion of his paper the author recommended the cultivation of flowers and aromatics in the British colonies, many of which, favoured by sun and climate, could be made to supply a great variety to the perfumer.

The discussion was opened by Mr. SIMMONDS, who, in the course of an interesting speech, suggested the pursuit of the alligator as a source of musk, and the cultivation of sandal-wood in Western Australia. Mr. S. PIESSE and Mr. LEWIS severally drew attention to the excise duty on spirit of wine as a hindrance to the full development of the perfumery trade in this country. The CHAIRMAN, in proposing a vote of thanks to M. RIMMEL, said that a short time ago he had extracted from an alligator two of the glands in the lower jaw which secreted the musk-like scent. The odour at first was intense and disgusting, but when dried he had no doubt it would be very agreeable to those who delighted in that perfume. He recently presented to the Zoological Society an animal which possessed on its back an orifice from which exuded a most offensive liquor. He had very little doubt if that liquor were diluted with water or spirit, it might become a very popular perfume. At all events, he would recommend the experiment to be tried.

The vote of thanks having been passed,

M. RIMMEL in acknowledging the vote, remarked that with regard to what had been stated by Mr. Simmonds as to the extraction of the musk from the crocodile, this was the first time he had heard of it In Ovid and Horace mention was made of a particular perfume called *Crocodileum*, which was supposed to be extracted from the crocodile. He treated

this, however, with disbelief; and thought that it was an invention of the Roman perfumers, who perhaps were not quite so truthful as their modern successors in the art.

The second conversazione of the present session was held on Saturday evening the 26th May, at the South Kensington Museum. The visitors, of whom about 2500 were present, were received by the Council of the Society as they arrived, and the room speedily presented a very brilliant appearance. In addition to the ordinary objects of interest in the museum itself, the Elliston collection of water-colour paintings were exhibited, as also were the Sheepshanks, Vernon, and Turner Galleries, while the band of the Coldstream Guards performed a choice selection of musical pieces, including pot-pourri from *Lurline*, and other operas of the day. Notwithstanding the large number of persons present, but little inconvenience was felt, except at times in the refreshment room. The company dispersed a little before midnight.

Chemical Society.—The next meeting of this society will take place on Thursday, June 7, when Dr. E. Frankland, F R.S. will deliver a discourse on the *Organo-Metallic Radicals.*

CORRESPONDENCE.

Economy of Sulphur.

To the Editor of the Chemical News.

Sir,—The great advance in the price of sulphur occasioned by the disturbances in Sicily makes this a favourable opportunity for agitating the question how far the enormous waste of sulphur, which has for so long a time been going on in this country, may be obviated.

Putting the manufacture of gunpowder out of the question, the greatest consumption of sulphur is for the manufacture of sulphuric acid for the decomposition of salt in alkali works; this acid is again decomposed and the sulphur turned out as refuse. In this refuse the sulphur is, or ought to be, in the state of sulphuret of calcium.

When sulphuret of calcium is treated by steam at a proper heat the lime is restored, and the sulphur passes off as sulphuretted hydrogen; now this latter may unquestionably be converted into sulphuric acid.

Again, there is an enormous waste of sulphur in the copper works at Swansea and the neighbourhood. A large portion of this sulphur is driven off into the atmosphere, causing much nuisance and damage; the remainder acting as a flux for the iron and earthy matters with which the copper is associated in the different ores is turned out as slag, which is attended with much expense and annoyance.

Now the whole of this sulphur might easily be recovered in a fit state for the manufacture of sulphuric acid.

The rich iron ores of Cumberland, Lancashire, Devon, and Somerset, may be converted into granulated metallic iron by a simple process.

An adequate quantity of this metallic iron added to the copper ore would retain the whole of the sulphur in the slag, which could easily be granulated while hot, and this, which may be termed artificial pyrites, would possess an important advantage in being free from arsenic.

Nearly all natural pyrites contain arsenic more or less, and when such is used for the manufacture of sulphuric acid the arsenic will be present in that acid; then when such acid is used for the decomposition of salt the arsenic will be present in the muriatic acid.

There can be little doubt but that much mischief is now occurring from this circumstance, although the cause is never suspected.

I have thrown these few ideas hastily together in the hope that they may draw the attention of some of your chemical readers to this subject, to which I shall myself return when more at leisure.—I am, &c.

C. G. Smith.

Fern Paper.

To the Editor of the Chemical News.

Sir,—It is almost impossible to be original in discovery of any kind, except of how much we are ignorant. I notice in your journal of the 19th inst. a proposal to manufacture paper from ferns in place of rags. In common with many other substitutes, such as wood, thistledown, nettles, jute and grass, this has been tried, but was found unfit for use, on account of the cost of working and the scarcity of the raw material. It is a vexed subject among paper-makers, upon which all practical men agree, that there is as yet no proper substitute for rags cheap enough to be used in their place, a fact which no theorist will believe, and even our wise Government Ministers treat with ridicule.

If the public taste would allow newspapers and books to be printed upon paper which need not be quite white, but tinted slightly "buff," many of these raw fibrous materials could then be used with advantage in its manufacture, for the bleaching of pulp made from them is the chief difficulty the paper-maker has to contend with in their use.

Ex-Chemicus may try the experiment of boiling the "curls" with some washing soda for six or eight hours, and pounding up the pulpy mass thus formed in a mortar and pestle, and when sufficiently fine pouring the pulp upon a piece of wire gauze (sixty wires to the square inch).

I am, &c. R. I.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Are Combinations of Two Chlorides Salts?—The clearest character of a salt, says M. P. P. Deheran[1], is the facility with which it will exchange one of its binary elements for another of the same nature, under certain conditions determined by affinity and the physical properties of the reacting bodies. Guided by this idea, M. Deheran has investigated the nature of the compounds formed of two chlorides.

The bichloride of tin decomposes a compound of the chlorides of copper and potassium:—

$$SnCl_2 + CuCl.KCl = Sn\,Cl_2.\,KCl + CuCl.$$

The new compound crystallises in octahedra. The bichloride of copper and the chloride of zinc precipitate from a combination with chloride of potassium and protochloride of copper:—

$$Cu_2Cl.KCl + CuCl = Cu_2Cl + CuCl.KCl.$$
$$Cu_2Cl.KCl + ZnCl = Cu_2Cl + ZnCl.KCl.$$

The chlorides of potassium, sodium, and ammonium, displace chloride of lead from a combination with chloride of mercury. The author gives a great many examples of analogous decompositions, and shows that they are effected under the same circumstances as decompositions of oxygen salts. He concludes, therefore, that the double chlorides are true salts, one chloride playing the part of an acid and the other that of a base. If the chlorides of the metalloids cannot form double compounds like the chlorides of the metals, it is because they are really anhydrides, and therefore ought not to give salts but amides.

Flattened Aluminium.—Wöhler[2] finds that aluminium leaf burns brightly in the air: it burns in oxygen giving a dazzling light. The alumina formed is as hard as corundrum. Aluminium wire burns in oxygen like iron, but the combustion will not continue because the wire fuses. Aluminium leaf will decompose water at 100° C. slowly. At first it assumes a bronze colour, and after boiling for some hours becomes translucent. By heating the residual powder with dilute chlorhydric acid, the metal not oxidised is dissolved, and the alumina remains in the form of plates insoluble in the boiling acid.

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[1] *Bulletin de la Société Chimique*, p. 85.
[2] *Annal. der Chem. und Pharm.* Bd. xxxvii.

On a Compound of Titanium and Aluminium.—Wöhler [3] fused in a clay crucible 10 grammes of titanic acid, 30 grammes of cryolite, 30 grammes of a mixture of equal parts of the chloride of potassium and sodium, and 5 grammes of aluminium. The mixture was kept at the temperature of the fusion of silver for about an hour. After the operation it was found that the aluminium had become lamellar, and when dissolved in caustic soda it left a quantity of brilliant crystallised plates, brown by iridescence, but which became colourless when moistened with dilute chlorhydric acid. These plates were found to be a compound of aluminium with titanium and silicium. Their density = 3·3, they are infusible by the blowpipe, and show some iridescence without oxidising further. Heated to redness in chlorine they burn brilliantly, and give chlorides of titanium, silicium, and aluminium. Chlorhydric acid attacks them slowly, disengaging hydrogen and forming oxide of silicium, The solution is violet coloured; alkalies give with it a black precipitate which by degrees becomes blue and then white. Nitric acid oxidises the plates energetically. The elements of the compound appear to be able to unite in various proportions.

Another experiment in which the mixture was only heated to the temperature of fused nickel, gave a compound richer in silicium, of a white colour, which had a density only = 2·7.

II. ORGANIC CHEMISTRY.

On the Formation of Fuchsine.—Fuchsine is obtained by boiling aniline with various metallic compounds, such as the bichlorides of tin and mercury, the perchloride of iron, the bromides, iodides, and fluorides of the same metals, the sulphates, nitrates, and chlorates of mercury, silver, and peroxide of iron, &c. and indeed with any salts of an oxyacid the base of which is capable of being brought to a lower degree of oxidation, or into the metallic state. M. Bechamp [4] has studied the formation of fuchsine with the view of finding out three things:—1. Whether the reaction is accomplished with or without loss of weight. 2. Whether the base of the intervening metallic compound is reduced or not. And 3. Whether the acid of the metallic salt is engaged in the formation of the new product. M. Bechamp has decided:—1. That the action is in every case effected without loss of weight. 2. That the base of the metallic compound is always reduced, and that whenever such is not the case no red colour is produced. 3. That the acid of the metallic salt is not directly concerned in the formation of the fuchsine, but is found unaltered in the rough product of the reaction.

Fuchsine is an organic base, but slightly soluble in water. In the hydrated state it is of a deep red colour. Pure, as it is isolated by precipitating the alcoholic solution with ether, it appears in the form of scales of a brilliant metallic green. The aqueous solution is red, and it dissolves with the same colour in alcohol, wood spirit, and acetone. It forms uncrystallisable salts, whose solutions are red when they are neutral, and yellow when an excess of acid is present. Sulphurous acid by degrees decolorises the solution, but by concentration and a gentle heat the red colour reappears; in this respect it behaves like the colour of rose petals.

The formula of fuchsine is one of the two following:—

$$C_{24}H_{10}N_2O_2 \text{ or } C_{24}H_{12}N_2O_2.$$

Its formation in certain cases is preceded by that of a white compound which is in direct relation with the reaction which gives rise to fuchsine—it is one term of the equation of that reaction, just as fuchsine itself is one term of the equation by virtue of which a violet colouring matter and new organic base of a yellow colour are produced. In a more extended memoir, M. Bechamp intends to give a full account of the new aniline compounds and the above mentioned bodies which precede or follow the production of fuchsine.

[3] *Annal. der Chem. und Pharm.* Bd. xxxvii.
[4] *Comptes Rendus*, t. l. p. 870.

Researches on Vulpinic Acid.—Möller and Strecker [5] have occupied themselves with some investigations on the nature and properties of vulpinic acid—a body discovered by Bebert in the *cetraria vulpina*, a lichen found in Norway, where the acid is used in combination with nux vomica to poison wolves. It is extracted from the plant by boiling with milk of lime, and separated by decomposing the lime-salt with hydrochloric acid, or it may be obtained from the lichen at once in a state of purity by means of chloroform. It is monobasic, and has the formula $C_{36}H_{12}O_9 + HO$, only differing therefore from usnic acid by the elements of water. It forms soluble crystallisable salts with the alkalies and alkaline earths, from which metallic vulpinates, generally insoluble, may be prepared by double decomposition. When vulpinic acid is boiled with baryta a new acid, *alphatoluylic acid*, $C_{16}H_8O_4$, isomeric with toluylic acid, is formed. By treating the baryta solution with hydrochloric acid, the new acid is obtained in the form of iridescent plates, which may be purified by crystallisation from alcohol, ether, or hot water. The crystals fuse at 76·5° C. and at 100° give off vapours which excite coughing. The boiling point is 265°·5, and the sp. gr. 1·3. The alkaline alphatoluylates crystallise with difficulty on account of their great solubility. Alphatoluylic acid resists energetically oxidising agents, but with a mixture of bichromate of potash and sulphuric acid it forms, as might be expected, essence of bitter almonds. With fuming nitric acid it gives a nitrated acid crystallising in needles.

When vulpinic acid is boiled with a solution of potash in such a way that the condensed vapours may run back to the liquid again, methylic alcohol is formed, and a new acid *oxatolylic acid*, $C_{32}H_{16}O_8$. The new acid is separated by hydrochloric acid and purified by means of alcohol. It crystallises in hard, colourless, rhomboidal prisms, which fuse at 154°, and decompose at a higher temperature. It is but slightly soluble in water even boiling, but ether and alcohol take it up readily. Oxatolylic ether forms colourless prisms like the acid, from which, however, they may be distinguished by their insolubility in ammonia and alkaline carbonates. With solid potash the acid is decomposed into oxalic acid and toluene; the authors therefore consider it as formed from the radicals of those bodies, and suspect its homology with benzilic acid.

III. TECHNICAL CHEMISTRY.

Alteration in the Transparency of Glass.—Some glasses, especially window glass, sometimes undergo a remarkable change after having been exposed to the air a long time. The change is not often noticed, because the glass retains its brilliancy and transparency, but it is seen immediately the glass is heated. Then the surface becomes covered with an infinite number of little cracks, which cross and interlace each other in all directions, and very thin pearly scales become detached, leaving the surface of glass with a corroded appearance. M. Spitzberger [6] proves that such glass has too much alkali and too little lime in its composition, and consequently the surface becomes hydrated. The hydrated silicate does not alter the appearance of the glass under ordinary circumstances, but the water is disengaged when the glass is made hot.

LABORATORY MEMORANDA.

A New Process for making Malleable Iron.—A beautiful and very simple process for decarbonising iron has recently been put in successful operation by the inventor, Professor H. K. Eaton, at Elizabethport, New Jersey. It consists in packing the cast metal in the white oxide of zinc, instead of oxide of iron, and heating the whole to redness, whereby the carbon of the iron is extracted, and metallic zinc distils and is condensed in a water-bath. By the method heretofore in use in this country for making malleable iron, the heat is usually kept up for eight or nine days

[5] *Annal. der Chem. und Pharm.* Bd cxiii. s. 56.
[6] *Moniteur Scientifique*, No. 82, p. 726.

in succession, and it frequently happens that great trouble and expense follow the process of decarbonisation in removing the small particles of metal that are reconverted from the oxide of iron in which the castings are packed, and which adhere to the surface In Professor Eaton's method all this trouble and expense are obviated. The oxide of zinc not only effects the decarbonisation in about forty hours, but, on account of the comparatively low temperature at which the oxide is converted, and its different constituency, nothing adheres to the surface of the castings, which come from the fire almost ready for finishing. The castings that have as yet been treated by this process are the smaller iron parts of harness hardware — such as rings, buckles, and links — and several kinds of cutlery, and parts of small machinery. It is claimed for the invention that it not only makes a far better kind of malleable cast-iron, but can be done at much less expense, as the time of keeping up the heat is greatly reduced and the product of the packing material is valuable. The formulæ of the process is as follows:—Oxide of zinc: zinc, 32; oxygen, 8; total, 40. So that if a mass of iron, or a number of pieces of castings, containing 6 lbs. of carbon, were packed in 40 lbs. of oxide of zinc, the 8 lbs of oxygen would separate from the zinc, and combine with the carbon of the iron, producing 14 lbs. of carbonic oxide gas, which would be lost in the atmosphere, and leaving 32 lbs. of pure metallic zinc, and the castings 6 lbs. lighter. So that, if the oxide of zinc costs 4½ cents per lb., and the metal was worth 7 cents, there would be a gain as follows:—40 lbs. oxide zinc, 4½ cents, 1 dol. 80 cents; 32 lbs. metallic zinc, 7 cents, 2 dols. 24 cents; gain 44 cents. So that one heat, using 40 lbs. of oxide of zinc, would cost 44 cents less than the price of the fuel required in the process, and the time of keeping up the heat is not more than one quarter of the old method. Another important fact connected with this way of decarbonising iron to render it malleable is the certainty with which the manufacture can be carried on. Nothing is left to guess-work, or, what is nearly the same thing, the conjecture of experience; for when the zinc ceases to distil, if there is an excess of the oxide of zinc present (which can always be provided for), it is certain there is no more carbon to be extracted from the iron and unite with the oxygen, and the process of decarbonisation is necessarily perfect. The specimens that have been dealt with by this method are found to be nearly chemically pure iron — silicates and phosphates being removed. — *American Railway Review.*

Employment of Chromic Acid to distinguish Silver.—A solution of chromic acid or a mixture of bichromate of potash and sulphuric acid, gives silver money, jewellery, or an alloy rich in silver, a purple red spot, due to the formation of chromate of silver. With the imitations of silver this does not take place.

MISCELLANEOUS.

How to preserve Potatoes.—According to M. Runge potatoes may be prevented from germinating by soaking them for 10 or 15 minutes in a solution containing one-tenth of its weight of common salt. When taken out of the solution and placed on the ground they quickly dry, becoming covered with a light saline pellicle.

Does a Red-hot Stove burn the Air? — There is a very common notion that if stoves or furnaces are heated red-hot, the iron will combine with the oxygen of the air; in other words burn it, and render it unfit for breathing. If we examine the facts we find that this idea is true to so small an extent as to make it of no practical importance. The compound which is formed by burning iron in atmospheric air is principally the black oxide, which consists of three equivalents of iron and four of oxygen (Fe_3O_4), that is 82 lbs. of iron to 32 lbs. of oxygen. Consequently, it will require 32 lbs. of oxygen to entirely consume a stove weighing 82 lbs. Now 100 cubic feet of air weighs about 122 oz. avoirdupois, of which the oxygen forms about 28 oz. It would consequently take all the oxygen in 1800 cubic feet of air to entirely consume a stove weighing 82 lbs. A stove heated red-hot and exposed to the air would certainly last as long as 10 months, and if it were completely burned in 300 days it would consume the oxygen in six cubic feet of air per day. Lavoisier and Sir Humphry Davy estimated that a grown person consumes 24 cubic feet of oxygen per day, which is the quantity contained in 115 cubic feet of air; consequently it would require at least 19 red-hot stoves to burn the air as fast as one pair of human lungs. We have made a safe estimate, and it is probable that a stove would last much longer than ten months, and therefore, that in fact 50 or 100 stoves would not consume oxygen as fast as the breathing of one man.

There are other considerations however to be taken into account in estimating the effects of red-hot iron on the human system. Heat from warm iron, below the temperature at which it is luminous, passes through crystals of rock salt as freely as any other heat, but this heat will not pass through glass; while that from red-hot iron will, showing that there is a difference in the nature of heat coming from red-hot iron and that from iron at a lower temperature. It may be that the effects of these different kinds of heat upon the human system are as different as their effects upon glass. The mode in which heat operates upon our bodies is very mysterious, and if there is sufficient evidence that heat from red-hot iron is injurious to our health, the truly philosophical method is to accept the fact and act upon it, whether we can find what is called an explanation or not.

Vegetable Tallow.—The Agricultural Bureau of the patent office has received specimens of vegetable tallow, known to botanists as *myristica sebifera*. It comes from a nut about the size of a nutmeg, full of meat, which being melted, becomes a yellowish tallow, excellent for candles. The plant is a native of Central and South America, and naturally attains a height of 10 or 12 feet; it carries herbaceous flowers from July till September, and makes so profuse a secretion of oily matter that this may be readily obtained from it, in the form of fat, by immersing it in boiling water. H. L. Clarke, Esq., United States Minister at Guatemala, writes that he has no doubt that this article might be collected and exported at considerable profit. It grows in immense quantities in the southern departments and in Verapaz. It is a susceptible of such high purification as to resemble the finest sperm, is solid, and quite as transparent. A sample of this production, in the nut and in the tallow, is now among the numerous collections of the patent office. The cultivation of it from the seed will be tried at the horticultural garden.—*Scientific American.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

T. W. S.—We translated the paragraph as we found it. The nitric acid no doubt should be strongest; the rest of our correspondent's queries we could not answer without repeating the experiment.

W. D.—Dissolve six parts of mercury in seven and a half parts of nitric acid sp. gr. 1·35. Mix two parts of this solution with 96 parts of olive oil and shake the mixture every half hour or oftener. If the oil is pure the mixture, after seven hours in summer or three or four hours in winter, will have congealed into a thick magma. If olive oil contains some other oil it thickens, but never becomes solid. *Faraday's Lectures* were issued some weeks ago: the price is 3*s.* 6*d.* The other query shall receive an answer next week.

Omicron.—We cannot put our hand on any account of the use of chloride of aluminium as a disinfectant. It could not be expensive, but we believe it would be worthless.

B. B.—Pyrophosphate of soda is made by heating the ordinary phosphate of soda. Our correspondent's other communication has not reached us.

A Subscriber.—We know of no work on the subject of very recent date, but you will find articles relating to it in *Knapp's Technology* and *Ure's Dictionary*.

A Subscriber.—Tarpauling for railway vans is made in several places. We do not know the exact composition of the paint which covers the canvas.

A Subscriber (Cupar).—The apparatus generally made use of now is Bunsen's Photometer, but our correspondent will find a simpler instrument invented by Dr. Ritchie, described in most scientific cyclopædias and books on light, which may answer his purpose, and which he may perhaps be able to make for himself.

☞ Reading Covers have been prepared for preserving the numbers of the Chemical News until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

Vol. I. of the Chemical News is completed with this Number. Handsome cloth cases, gold lettered, for binding the volumes have been prepared, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

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THE CHEMICAL NEWS.

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TO OUR READERS.

THE commencement of our second volume affords the opportunity for saying a few words on the present position and future prospects of the CHEMICAL NEWS. Originally started to supply a want which had long been felt and expressed in scientific circles here in London, this journal has attained a circulation on the continent of Europe and in America, as well as in Great Britain, which we believe was never reached by any other periodical devoted to the same department of knowledge. This flattering result of our labours we accept as a proof of success, and also as a stimulus to future exertions.

In no science is the necessity for a journal, published at short intervals, so clearly seen, and the advantages of one so distinctly felt, as in Chemistry. So extensive is the science, and so numerous are the experimenters engaged in its pursuit, that it may be said no day passes without the discovery of some new compound, or the registration of some new fact. To record these, and thus rapidly diffuse a knowledge of scientific progress, not only throughout Great Britain, but over the rest of the world, has now been recognised by scientific men as the especial province of the CHEMICAL NEWS.

But it is not only science in the abstract which demands the attention of the journalist. The applications of Chemistry to the arts and manufactures are so numerous as almost alone to require a special journal for their development and discussion. In consequence of the extended reports we have hitherto given of the meetings of the learned societies the room for technical articles has necessarily been at times limited. The demands on our space having lately become so numerous, we intend in future to reserve verbatim reports of lectures only for the most important, believing that our readers would in most instances be as well satisfied with a condensed abstract. This will leave us more room for articles of a practical character on various subjects of commercial and technical interest.

The permanent value of a work which contains so great a number of facts distributed over so large a number of pages, necessarily depends on the perfection of the Index, and consequently the greatest pains have been taken to render that of the volume just completed as copious and perfect as possible. It has occupied the unremitting attention of the Editor for many weeks past, and it is confidently hoped that it will in great measure tend to raise the CHEMICAL NEWS from the ephemeral position of a mere periodical into that of a standard work of reference.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on the Numerical Relations between the Specific Gravities of the Diamond, Graphite, and Charcoal Forms of Carbon and its Atomic Weight, by Dr. LYON PLAYFAIR, *C.B. F.R.S.*

[*Read before the Royal Society of Edinburgh.*]

RECENT researches have shown that there is an intimate relation between the specific gravities and atomic weights or equivalents of solid or liquid bodies. This relation is not so simple as that which prevails in regard to the volumes and combining numbers of gaseous bodies, and yet it is sufficiently marked to indicate many important chemical analogies. The formula for eliciting these relations is—

$$\frac{E}{d} = V,$$

in which E is the equivalent, *d* the specific gravities, and V the atomic volume.

It is to be borne in mind, that the unities or starting-points for specific gravities and for atomic weights are essentially distinct. In the first case, the weights of the bodies are compared with the weight of an equal bulk of water; in the second instance, the combining numbers refer to a unit weight of hydrogen. Nevertheless, the relations observed between the specific gravities and the atomic weights are well marked in bodies of a like character.

It has always been considered interesting to examine these relations in regard to carbon, which has three well characterised allotropic forms. The atomic volumes obtained by the above formula show no satisfactory relations between the numbers obtained for each of the states in which the element presents itself.

Before we examine them in another way, it is desirable to obtain a mean specific gravity for the diamond, graphite, and charcoal, as the recorded results of experiment show a considerable variation.

1. **Diamond.**—The specific gravity of this gem is generally stated in elementary works to range from 3·5 to 3·55; but these numbers do not represent the mean of recorded experiments, as will be seen by the following table:—

Diamond in Hunterian Museum, Glasgow	3·53	Thomson.[1]
Specific gravity, as stated by Mohs	3·52	Mohs.[2]
Brazilian diamond	3·44	Brisson.[3]
Another variety of the same	3·52	
Mean specific gravity of a "beautiful collection of diamonds"	3·48	Lowry.[4]
"Star of the south"	3·53	Dufrenoy & Halphin.[5]

[1] *Thomson's Mineralogy*, vol. i. p. 46.
[2] *Mohs' Mineralogy*, vol. ii. p. 306.
[3] *Brisson*, as quoted by *Böttger*, *Specifisches Gewicht*, p. 32.
[4] *Lowry*, as quoted by *Thomson's Mineralogy*, vol. i. p. 46.
[5] *Dufrenoy*, *Comptes-Rendus*, vol. xi. p. 3.

Borneo diamond	3·49	Grailich.[6]
Do. do. compact	3·41	Rivot.[7]
Do. do. do.	3·25	Rivot.[7]
Diamond used in Jacquelain's experiments	3·33	Jacquelain.[8]
Specific gravity, as given by Henry	3·55	Henry.[9]
Well crystallised Brazilian diamond, weighing 0·5761 gramme in the Edinburgh Museum	3·48	Playfair.[10]
Mean sp. gr.	3·461	

If we reject the second Borneo diamond of Rivot, which has too low a specific gravity, we have a mean sp. gr. of 3·48, which is the same number as that found by Wilson Lowry for the mean specific gravity of "his beautiful collection of crystallised diamonds." (*Thomson's Mineralogy*, vol. i. p. 46.)

It is to be expected that the experimental determination of the specific gravity of diamonds should be rather above than below the truth; for we are aware that they all leave a minute quantity of ash on burning, and that this ash, according to Petzhold, contains silica and iron.

2. **Graphite.**—This variety of carbon is often impure, being not unfrequently contaminated with upwards of five per cent. of earthy impurities. Recorded specific gravities upon such impure specimens are of no value for the mean result as regards pure graphite. The following determinations are all those which I can find upon specimens which have been chemically examined to establish their purity:—

Natural graphite	2·27	Regnault.[11]
Do.	2·25	Schrader.[12]
Do.	2·32	Schrader.[12]
Graphite of iron furnaces	2·33	Karsten.[13]
Natural graphite, in fine crystalline plates	2·14	Breikhaupt.[13]
Do. do. another variety	2·22	Breikhaupt.[13]
Do. do. do.	2·23	Kengott.[14]
Natural graphite	2·50	Pelouze and Fremy.[15]
Gas carbon graphite	2·35	Graham.
Mean sp. gr.	2·29	

It would have been interesting to have added to this list a determination of the specific gravity of Brodie's purified Ceylon graphite; but its minute division causes the air to adhere to it so tenaciously that I have failed in getting any correct determinations of its density.

3. **Charcoal.**—There are comparatively few determinations of the specific gravity of pure charcoal. It is in fact not so easy to obtain this substance. A specimen of charcoal from pure sugar, repeatedly calcined, and treated with chlorine to remove the last traces of hydrogen, and again calcined, gave me the sp. gr. 1·80; but bubbles of air still adhered to it, although it was kept for several hours under a good air-pump. The following determinations are those recorded:—

Pure lamp-black	1·78	Baudrimont.[16]
Fibrous gas coke	1·76	Colquhoun.[17]
Compact gas carbon	2·08	Baudrimont.[18]
Powdered coke (mean)	1·80	Regnault.[19]
Charcoal from alcohol	2·10	Scholtz.[20]
Charcoal from sugar	1·80	Playfair.[21]
Pure chorcoal, without pores	1·84	Griffith.[22]
Mean sp. gr.	1·88	

[6] *Grailich Bull. Geol.* [2] vol. xiii. p. 542.
[7] *Rivot, Ann. des Mines*, vol. xiv. p. 423.
[8] *Jacquelain, Ann. de Ch. et Phys.* [3] vol. xx. p. 459.
[9] *Henry's Mineralogy*, vol. iv. p. 19.
[10] Experiment made for this paper.
[11] *Regnault, Ann. de Ch. et. Phys.* vol. lvi. p. 37.
[12] *Schrader, Annals of Philosophy*, vol. i. p. 299.
[13] As quoted in *Bottger's Specifisches Gewicht.*

4. From the preceding data we take the mean specific gravity of the three varieties of carbon to be as follows:—

	Mean Sp. Gr.
Diamond	3·48 or 3·461
Graphite	2·29
Charcoal	1·88

5. We have now to consider whether these numbers stand in any simple relation to their atomic weight. The formula

$$\frac{E}{d} = V$$

gives the following atomic volumes, taking $\Theta = 12$.

	Atomic Volumes.
Diamond	3·44
Graphite	5·24
Charcoal	6·38

These numbers do not bear to each other any simple relation.

6. If we now take the atomic weight of carbon ($\Theta = 12$), and then extract from it its square, cube, and fourth roots, numbers are obtained which bear a striking approximation to the mean specific gravity of the three forms of carbon:—

	Roots.		Sp. Gr.
1	$\sqrt[2]{12} = 3{\cdot}464$		Diamond, 3·48 or 3·46
2	$\sqrt[3]{12} = 2{\cdot}289$		Graphite, 2·29
3	$\sqrt[4]{12} = 1{\cdot}865$		Charcoal, 1·88

In other words, if we raise the specific gravity of diamond to its second power, that of graphite to its third power, and that of charcoal to its fourth power, we obtain numbers closely approaching in each case to 12, the atomic weight of carbon.

Diamond	$3{\cdot}48^2 = 12{\cdot}11$
Graphite	$2{\cdot}29^3 = 12{\cdot}00$
Charcoal	$1{\cdot}88^4 = 12{\cdot}49$

These approximations are remarkable, and the relations of the numbers are natural and simple. The differences between the mean experimental numbers and the corresponding roots of the atomic weight of carbon are not so great as the differences observed in the specific gravities of the same form of carbon.

7. It may be useful to condense into the form of a table the previous observations:—

Forms of Carbon.	Experiment.		Calculations.	
	Sp. Gr.	Power	C	Roots.
Diamond	3·46 or 3·48	$= 12{\cdot}11$	$\sqrt[2]{12}$	$= 3{\cdot}464$
Graphite		$2{\cdot}29^3 = 12{\cdot}00$	$\sqrt[3]{12}$	$= 2{\cdot}289$
Charcoal		$1{\cdot}88^4 = 12{\cdot}49$	$\sqrt[4]{12}$	$= 1{\cdot}865$

These relations appear to be so simple that it is scarcely possible to conceive that they may not have been described before; but I have been unable to find such descriptions. The nearest approach to it which I know is the fact that Mr. Hawksley, the engineer, stated to me, many years since, that he had brought under the attention of the late Mr. Cooper the relation which seemed to subsist between the specific gravities of silver and gold and their atomic weights, this being approx-

[14] *Kengott, Wien Akad.* vol. xiii. p. 469.
[15] *Traité de Chimie*, vol. v. p. 518.
[16] *Baudrimont, Traité de Chimie*, vol. i. p. 511.
[17] *Colquhoun's Annals of Philosophy* [2] vol. xii. p. 1.
[18] *Baudrimont, Traité de Chimie*, vol. i. p. 514.
[19] *Regnault, Traité de Chimie*, vol. i. p. 369.
[20] *Böttger Specifisches Gewicht.*
[21] Experiment recorded above.
[22] *Böttger Specifisches Gewicht.*

matively the square root of their atomic weights, or of multiples of these numbers. But I cannot find any record either of Mr. Hawksley's or Mr. Cooper's views on the subject.

PHARMACY, TOXICOLOGY, &c.

On the Chemical Reactions of Strychnia, by H. Letheby, *M.B. &c. Professor of Chemistry and Toxicology in the College of the London Hospital.*

The medico-legal chemistry of strychnia has been very fully investigated during the last few years, and Dr. Wormley's paper on the chemical reactions of the alkaloid is a valuable *resumé* of the subject.[1] It will be noticed, however, that his results are always obtained by adding the tests to a known quantity of the *pure* alkaloid, a condition which is not at once secured in toxicological research. Experience, therefore, has shown that some of the tests must be applied with certain precautions, or the results will be very unsatisfactory. Those who are conversant with the practice of the matter will not agree with Dr. Wormley that the colour test, for example, is to be employed in the way described by him. "We have succeeded best," he says, "by placing the strychnia, or a drop of the solution evaporated to dryness, in a watch glass, and by its side a drop of sulphuric acid into which a fragment of bichromate of potash was introduced, and stirred until it imparted a yellow colour, then by inclining the watch glass the coloured sulphuric acid was allowed to flow over the strychnia.[2]" This mode of experimenting is dangerous in every way, for, in the first place, if the bichromate is in excess, and the quantity of strychnia small, the colour is so evanescent as to be uncertain, and, secondly, if organic matter be present, the colour will be masked; and, thirdly, if a nitrate or chloride is with the strychnia, the colour is not produced at all; and, fourthly, if strychnia be entirely absent, but sugar and bile, or piperine, or any of those substances be present which give a purple or red reaction with sulphuric acid, a fallacious result will be obtained; and lastly, if the result fails, the whole of the strychnia is lost, and the inquiry brought to an unsatisfactory conclusion.

So strongly have I felt these difficulties, that in my paper on the *Medico-legal Chemistry of Strychnia*, published in the *Lancet* of June and July 1856[3], I have endeavoured to guard the operator against them by describing a process which generally ensures success. It is as follows:—"First place the strychnia, or the suspected matter, on a clean white plate; then touch it with a small drop of concentrated sulphuric acid (the acid should be free from nitric acid); stir it about with a glass rod, so as to mix the strychnia very perfectly with the acid; allow it to remain in this state for a few minutes, and if the strychnia be pure there will be no discoloration.[4] Then cautiously add the reagent, namely, peroxide of lead, bichromate of potash, or peroxide of manganese, taking care not to add too much of it; in fact, it is best done by dropping the powder into the oil of vitriol and strychnia from the point of a penknife. Lastly, either incline the plate so that the acid may gently flow over the powder, or else with great caution stir the powder about with the point of a glass rod. In this way the colour is always sure to be brought out, and, as far as I know, it is not to be confounded with the reaction of any other substance. Indeed, the only thing which approaches it in appearance is the dirty violet colour which is occasioned by morphia and its salts when they are treated in the same way. As to the so-called fallacies to the test, namely, salicine, bile, sugar, pyroxanthine, piperine, resinous matters, and many other things, it must be manifest that they are not fallacies when the test is properly performed, for all these compounds acquire their colour directly the sulphuric acid is added to them, and *before* the other reagent is applied.

"Of all the substances which have been proposed for thus developing the tints with strychnia, bichromate of potash is assuredly the worst, for—.

"1st. It is itself coloured by the acid, and may thus complicate the result.

"2nd. It will not act when organic matter is present, as for example, the vegetable acids,—citric and tartaric, cream of tartar, tartar-emetic, potassio-tartrate of soda, the residue of an effervescing draught, sugar, gum, and even a little morphia.

"3rd. It will not act when nitre, nitric acid, or common salt are present with the strychnia.

"4th. It is of all the tests the least delicate: for while the peroxide of manganese, or the peroxide of lead, will discover the presence of the $\frac{1}{10000}$th of a grain of strychnia, the bichromate will not act well with less than the $\frac{1}{1000}$th of a grain.

"It is true that by means of the process which I shall hereafter detail for extracting the alkaloid, none of those impurities will be present; yet, in making a comparison of the respective values of the several tests, it is right to know that the bichromate of potash reaction is the least satisfactory.[5]"

The true cause of its want of delicacy is the rapidity with which it oxydises the alkaloid; and therefore the peroxides of manganese and lead, because of their evolving oxygen slowly, are more delicate and suitable to the purpose, for their reactions take time to develop and the colour is far more enduring. Finding that the *modus operandi* of the test was the action of nascent oxygen upon the strychnia, it occurred to me that the galvanic current might be used instead of the oxygen compound.

"The mode of applying the galvanic test is as follows:—Place a drop of a solution of strychnia (say of one part of the alkaloid in 10,000, or even 20,000, of water) into a cup-shaped depression made in a piece of platinum foil. Allow the fluid to evaporate, and, when dry, moisten the spot with a drop of concentrated sulphuric acid. Connect the foil with the positive pole of a single cell of Grove's or Smee's battery, and then touch the acid with a platinum terminal of the negative pole. In an instant the violet colour will flash out, and, on removing the pole from the acid, the tint will remain."[6]

By this mode of proceeding the colour is perfectly under control, and the test is free from every known source of fallacy. I have lately applied it in the recognition of strychnia in the urine of a girl poisoned at Peterborough, and the results were very satisfactory. They were confirmed by the physiological action of the poison, obtained from the urine, on frogs.

Lastly, I would remark that the carbazotic acid, and iodine tests, which Dr. Wormley says he has not seen described, are fully discussed in my paper, and drawings of the crystalline precipitates are given.[7]

[1] Chemical News, pp. 218 and 242.
[2] *Ibid.* p. 243.
[3] See *Lancet*, June 28, 1856, and July 12, 1856.
[4] The process to be followed for rendering the strychnia pure is detailed at page 37 of the *Lancet* for July 12, 1856; it consists in treating the impure strychnia with concentrated sulphuric acid until all the impurities are destroyed and then extracting with chloroform or ether.
[5] *Lancet*, June 28, 1856, p. 708.
[6] *Ibid.*
[7] *Ibid.* p. 707, and July 12, p. 37.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 27, 1860.

On recent Applications of Science, contributing to the efficiency and welfare of Military Forces, by F. A. Abel, *Esq. Director of the Chemical Establishment of the War Department.*

Four years have elapsed since I attempted, in this Institution, to give a general description of the applications made of chemical science in connection with military manufactures. The exertions made during the war, just then terminated, to increase the efficiency of our armaments and military establishments, had been productive of important improvements in many directions. Since that time the condition of the soldier has continued to receive that serious attention on the part of the nation and the government which it both merited and urgently required, and the beneficial results of which may be readily traced in almost every arrangement connected with the military service. Not only do we find that important improvements have been effected in the arms and implements of the soldier; his condition when on active service has also been much improved of late; his homes are arranged with greater regard to health, cleanliness, and general comfort; he is more appropriately clothed and also better fed. It may be true that many of these benefits have reached him somewhat tardily, and there is also no doubt that much remains to be done in order to secure to the military service the full advantages of the many improvements which have been effected in the applications of physical, chemical and mechanical sciences. Nevertheless I venture to hope that you will have reason to be satisfied with the account, imperfect and superficial as it must necessarily be, which I shall endeavour to lay before you this evening of the recent applications of science to military uses.

The first subject to which I would direct your attention is perhaps the most important one in connection with military equipment. It relates to the influence which recent achievements in mechanics and metallurgy have exercised upon the efficiency of fire-arms. I must not attempt to examine into the gradual perfection of the rifled small arms and their projectiles, or into the numerous plans which have been tried, with more or less success, within the last few years, for applying the principle of rifling to cannon. You must allow me to confine myself to a brief description of the circumstances and results which have gradually led to the employment of new material and new processes of manufacture in the construction of cannon, and which have resulted in the production of such admirable pieces of ordnance as those of Sir W. Armstrong and Mr. Whitworth.

Permit me to remind you that until within a very recent period only two materials were applied to the construction of cannons, namely cast iron and bronze, or rather, an alloy similar to bronze, consisting of copper and tin, generally termed gun-metal, and by military men called brass. Of these, gun-metal is by far the most ancient. Accounts exist of bronze guns cast in France and Germany as early as 1370, and from that time until the close of the 15th century this material gradully replaced wrought iron, of which the first guns were constructed. Early in the 12th century guns were constructed of wrought iron, and it is very interesting to note that although the system of construction of early guns was naturally carried out in a most crude and imperfect manner, the principles on which it was based are exactly those, to the application of which, in the construction of cannon, we are now returning in the 19th century. In illustration of this let me direct your attention to a drawing of the celebrated Mons Meg, a gun constructed about the year 1450, which is still to be seen at Edinburgh Castle. This gun is built of staves, arranged like the staves of a barrel, and of hoops which had been placed on to the staves side by side while hot, so as to become firmly fixed by contraction. Various other old guns constructed on the same principle exist at the present time; thus, there is a very large one in Ghent said to have been manufactured in the year 1302 and which is constructed very much in the same way. Now, although the gunpowder of those days was comparatively weak and the projectiles (which were generally of stone) were much less heavy than those of the present time, the powers of endurance of these guns proved to be very small. It is therefore not surprising that, from the time when bronze was first applied in this direction, the guns constructed of a number of pieces should have been gradually superseded by ordnance cast in one piece, although the material thus substituted for iron was very expensive.

Cast iron appears to have been employed for shot and shell as early as 1378, but it was not until in the reign of Charles the Second (about 1660) that it was applied to the production of cannon. From that period its employment speedily became general, though it has never in any country entirely superseded gun-metal, which, on account of its greater tenacity, has been always employed as a material for light field guns. This alloy, however, possesses very serious defects as a material for guns, arising principally from the uncertainty attending the production of thoroughly sound castings, and from its considerable softness. Numerous experiments have, in consequence, been made with the view to discover some alloy of copper which should at least equal gun-metal in tenacity, and should possess greater hardness and uniformity. I have here a few specimens of some alloys and compounds of copper which have been proposed within the last five years as substitutes for the alloys of copper and tin, and I will just allude briefly to their composition, inasmuch as some of them are intimately connected with recent remarkable technical discoveries. The metal aluminum, first produced in any quantity by Deville, possesses certain physical properties which appeared likely, at first sight, to render its alloys with copper valuable substitutes for gun-metal, although their expense would at present greatly exceed that of the latter material. Alloys of aluminum and copper were made and experimented upon (here is one containing ten per cent. of aluminum), and it was proved that although they possessed important advantages over gun-metal in point of lightness, tenacity, and uniformity, they exhibited defects which were fatal to their application in this direction. Thus, aluminum is powerfully affected by alkaline substances, and consequently when its alloys are brought into contact with the solid products of decomposition of gunpowder, and with moisture, particularly at a high temperature, they become rapidly corroded. Here is an alloy of copper with another element which has recently excited great interest, namely silicon; it contains 4 per cent. of this substance. Some of the compounds of silicon and copper possess the hardness of steel and the tenacity of wrought iron; and if some difficulties in their preparation upon a large scale were overcome, there is little doubt that some one of them would prove a valuable substitute for ordinary gun-metal. The compounds of phosphorus with copper also possess several valuable properties. It is found that phosphorus (which is so detrimental to iron) when contained in copper, in the proportion of from 2 to 4 per cent., imparts to that metal very considerable tenacity and hardness. Ordinary gun-metal bears an average strain of about 35,000 lbs on the square inch, while copper containing a small proportion of phosphorus will bear a strain of 48 or 50,000 lbs on the square inch. For the preparation of phosphuretted copper upon a large scale it is advisable to coat the pieces of phosphorus with copper, by immersing them for a short time in solution of sulphate of copper so that they may be handled with perfect safety. If they are then thrown into the melted copper, the film of metal on their surfaces will protect them efficiently from oxidation and, as the liquid copper combines very rapidly with the phosphorus, very little loss of the latter is incurred. It is probable, from the preliminary results which we obtained with these compounds at Woolwich, that the phosphuretted copper would

have become of practical importance in connection with the subject of gun-metal, had not the improvements in the treatment of wrought iron not only led to the dismissal of bronze from the military service but also, by their results, thrown into the shade any of those obtained with the materials just described.

I will endeavour, as briefly as possible, to give some account of the course of events which has led to this important change in the description of material employed for field guns. Among the many experiences gained during the recent war, some most important data were collected with reference to the enduring powers of cast-iron guns. These were found to be exceedingly variable, and appeared to be in great measure regulated by circumstances and conditions (attending the conversion of cast iron into guns of heavy calibre) which were scarcely under the control of the metallurgist or which, up to that time, had not received their fair share of consideration on his part. Let me direct your attention for a moment to the very great diversity in appearance and properties, observable in the material known under the general term of cast iron. In looking at these specimens of cast iron you will be at no loss to discover a very considerable difference in the appearance of most of them; a difference which is borne out by fully as great a variation in their physical properties and chemical composition. Here is a very dark specimen, with glistening fracture, containing a considerable proportion of carbon in a peculiar condition; in the graphitic form, as it is called. Here again we have another equally dark iron of a very close-grained fracture, containing as much carbon as the other and in the same chemical condition; but its structure gives us a different idea of its strength which is, indeed, much greater than that of the former. These two specimens, though chemically alike, are remarkably different in physical structure and properties. If we pass a little further along this row of specimens, we find the iron gradually becoming lighter in colour and presenting, to the close observer, in some instances a mottled or granitic appearance, in others a white crystalline structure. These variations are principally due to the difference in the chemical condition in which certain portions or the whole of the carbon exist. Here is a specimen of light grey iron, of very fine grain, exceedingly weak as compared with that close-grained dark grey specimen; it contains a large proportion of the element silicon; and here is another, of a peculiar mottled appearance, which is rich in phosphorus. These, and many other impurities which are acquired by iron, in a great variety of proportions, during its reduction in the blast-furnace, all exert an influence on the physical properties of the metal; some, such as the phosphorus and silicon, being much more prejudicial to its quality than others. This being the case, you will readily understand how difficult it must be, even when the greatest care and discrimination are exercised in the selection of cast iron for conversion into cannon, to obtain anything approaching uniformity in the material employed. But in addition to these difficulties, others, no less formidable, of a physical character, interfere with the production of large castings of uniform strength, which it is impossible for me to consider in this Lecture; I merely wish to impress upon your minds that there are many and important causes of the want of uniformity in cast-iron guns. I could bring before you numerous instances of the wonderful powers of endurance exhibited by cast iron cannon. Thus, records exist of many, cast in this and other countries (some used during the late war), from which 2000 and even 3000 rounds have been fired without their having burst; and I may mention to you the case of a Spanish 32-pounder cast-iron gun, which did not burst until 3 tons 13 cwt. of powder, 2 tons of shot, and 13 cwt. of wad, had been fired from it. On the other hand, we have instances almost innumerable of guns bursting at proof or after comparatively very short service.

The causes of the very general want of durability of the large mortars used in the bombardment of Sweaborg have been made the special subject of research and experiment, the results of which were unfavourable, partly to the employment of cast iron for the construction of heavy pieces of ordnance, and partly to the system of casting such guns, hitherto practised. Some very valuable researches and experiments on the construction and powers of endurance of cast iron guns were also made the subject of a Report by the United States Government a few years ago; important results were arrived at in those investigations which are being still further elaborated, and there appears reason to believe that some very considerable improvements will yet be effected in the methods of preparing cast iron as a material for ordnance, and of casting guns. Meanwhile, however, the importance of securing without delay more uniformly durable guns to which the principle of rifling could be applied with greater security than was the case with cast iron, became an additional inducement for the renewal of attempts which, for many years past, had been made from time to time, to produce wrought iron cannon of large calibre, forged in one mass.

Nasmyth and other engineers and metallurgists undertook experiments in this direction, but although sound guns of small calibre (from 3- to 9-pounders) have been produced by welding small masses of malleable iron as rapidly as possible, the attempts to produce very large forgings almost always resulted in failures, principally in consequence of the remarkable change effected in the physical structure of wrought iron, by being repeatedly subjected to the heat necessary for the addition of fresh portions to the mass. The fine fibrous structure of the metal was thus gradually destroyed, giving place to a coarse lamellar structure, whereby the strength of the iron was so injured as to render it incapable of resisting the strain created by the explosion of large charges of powder. The difference in structure which I allude to is well shown in these two specimens. And you will readily understand that this was one very important cause for abandoning this system of constructing cannon. I should mention, however, that one very large gun (of 13 inches calibre), which has successfully withstood severe trials, has been constructed on this principle by the Mersey Company, who presented it to the nation.

While experiments of this class were being carried on, several scientific men, looking at the question of the construction of cannon from a mathematical point of view, arrived at the conclusion that the true principle was to build up guns of numerous parts, so combined as to assist each other, by their elasticity and tenacity, in resisting the force of exploding gunpowder. Thus Captain Blakeley, Mr. Mallet and others eventually produced guns of very great enduring power, by constructing cylinders or rings of metal over which were placed others, whose internal diameter, when cold, was less than the external diameter of the first cylinders, but which, when heated, would expand sufficiently to admit of their being placed in the required position; these rings are thus not only firmly fixed in their position, when cold, but, by their contraction, they also effect a considerable compression of the metal of the inner cylinder, while they themselves remain in a state of tension.

The whole mass of metal is thus arranged in conditions most favourable to the effectual resistance of a sudden strain applied to the interior of the cylinder. A gun constructed on this principle by Captain Blakeley has given most successful results; two enormous mortars have also been constructed of rings by Mr. Mallet, and although the trials made of one of these were only partially successful, the correctness of the principles to which I have referred were in no way impugned by the results obtained.

In directing your attention to some beautiful photographs in the library, illustrative of the construction of Mr. Mallet's mortar, I must embrace the opportunity to refer to the very important applications which are made of the photographic art to military purposes. Not only is it employed as affording the best mode of recording the results of experiments; it is used with equal advantage for communicating in the clearest possible manner to mili-

tary authorities at a distance any changes introduced in the nature and arrangements of military equipments, and it also affords important assistance to those entrusted with the instruction of the soldier. You will see in the library numerous illustrations of these important applications of photography.

But to return to the subject under discussion, the construction of guns of numerous pieces—there can exist no more convincing illustration of the successful manner in which this system admits of application to the production of light and durable guns, than that afforded by the methods now in use for the construction of Sir W. Armstrong's beautiful rifled cannon, which has already been introduced as the service field-gun. The nature of this gun has been so explicitly described in public journals that I need not now dilate upon it. I will ask you, however, to allow me to give a very brief description of the manner in which the principles just now referred to are carried out in its construction. The gun consists essentially of rings, partly welded together so as to produce a cylinder or barrel of sufficient length, and partly shrunk one upon another, so as to impart the requisite strength to the structure. The rings themselves are from two to three feet in length and are formed out of bars from forty to ninety feet long and three or four inches thick, which are coiled up closely when at a red heat, into spiral tubes, the form of which is represented by this piece of coiled lead, and afterwards welded into solid rings by a few blows from the steam hammer, applied to one end of the white hot coil while in a vertical position. The rings are joined together to form the gun-barrel, by raising to a welding heat the proximate extremities of two rings, placed end to end, and then applying a powerful pressure to the cold end of each ring. In the large guns a second layer of rings is shrunk on to the first set, or the barrel, throughout the length of the gun, but in the smaller guns it is only behind the trunnions that two additional rings are shrunk on, one over the other. The outer ring is exactly like those already described but the intermediate one is prepared by bending two iron slabs into a semi-cylindrical form and then welding them together at the edges. In this way a cylinder is obtained in which the fibre of the iron is arranged longitudinally instead of transversely, as in the other rings. This arrangement is adopted because that part of the gun has to sustain the principal force of the thrust upon the breech, on the discharge. It is into this portion that the breech-screw (made of steel) fits, by means of which a movable plug of steel, provided with a soft copper washer, is pressed up against the end of the barrel, when the gun has been loaded. The breech-screw being hollow, the charge is introduced through it into the gun, on the removal of the plug. This gun, built up of so many pieces accurately welded, turned and fitted; with its thirty or forty grooves; its neat lever arrangement for working the breech-screw; its admirable sights for giving direction, and various other arrangements, contrived so as to render it a most complete and perfect weapon, is undoubtedly very costly as compared with the ordinary cast iron gun. But, owing to the admirable system of manufacture and the beautiful mechanical appliances brought to bear upon the production of each part, the original cost of the gun has already been very much diminished; on comparing the price of a 12-pounder Armstrong gun with that of a bronze gun of the same calibre, which it has now superseded, the latter is found to be about double the expense. The price of iron used for the manufacture of the Armstrong gun is 19*l.* per ton; it is the best description of malleable iron, bearing a tensile strain of about 74,000 pounds on the square inch. The present cost of a 12-pounder gun (weighing 8 cwt.) is about 93*l.* The value of gun-metal is about 125*l.* per ton and the cost of a 12-pounder gun of this material (weighing 19 cwt.) is 175*l.* 10*s.* Of the latter, it may be said that when no longer serviceable it may be re-cast, while an old Armstrong gun cannot be reconverted into a new one. But, on the other hand, the average number of rounds which can be fired from the old gun before it is unserviceable scarcely exceeds 1000, while the limit to the powers of endurance of the Armstrong gun is not yet known. I have seen one from which between 5000 and 6000 rounds had been fired without any vital injury to the gun.

But while the important results which have been obtained with guns of wrought iron, built up of rings, must receive their full share of our admiration, we must not lose sight of others, scarcely less valuable, which have attended the application of materials, varying in their nature between steel and malleable iron, to the production of light guns, cast in one piece.

M. Krupp of Essen was the first to produce masses of cast steel of sufficient size for conversion into cannon. A 12-pounder gun cast of this material was tried here several years ago, and it withstood the severest proofs without bursting. A cast material somewhat similar in character to M. Krupp's steel, and to which the name of homogeneous has been given, has been most successfully applied by Mr. Whitworth, not only to the production of the barrels for his rifle small-arms, but also to the manufacture of his beautiful rifle-cannon. The 12-pounder gun represented by this diagram is prepared of this material solely, being cast in one mass, and afterwards forged. The heavy guns (80 and 100-pounders) consist, however, of cylinders of homogeneous iron upon which hoops of fibrous iron are forced by hydraulic pressure, the breech portion receiving hoops of puddled steel.

It would be quite out of place for me to attempt to enter into a discussion of the relative merits of the two admirable rifle guns and their projectiles which have been produced by Sir W. Armstrong and Mr. Whitworth. My present object in referring to them is only to use them as illustrations of different systems adopted for the construction of cannon. I may venture to state, however, that, as far as the construction of the gun is concerned, the small Whitworth guns undoubtedly possess the great advantage of simplicity over the compound guns just described; but the present high price of the material of which they are cast gives the Armstrong field-guns the advantage in point of cost. There can be little doubt, however, that the facilities for producing material of this description will increase with the demand, and there appears no reason why the process of Mr. Bessemer, which has recently been applied with great success for the conversion of iron of good chemical quality into excellent cast steel, upon a very considerable scale, should not be resorted to for the production, at a moderate cost, of masses of cast steel, or of a similar material, of sufficient size for conversion into cannon of all calibres, excepting perhaps the very largest, which it will possibly be always found most advantageous to construct of several pieces, upon the principles just referred to.

In passing from the subject of the construction of fire-arms, to other matters of interest which I am anxious to bring to your notice, I may mention that the general application of the system of rifling to all fire-arms, has rendered indispensable a careful revision of the descriptions of gunpowder hitherto used. The results of a long series of experiments, still in progress, have already led to the modification of several important points in the manufacture of powder, whereby a greater uniformity in the action of the latter is ensured, and its explosion regulated, with special regard to the double work which it now has to perform in the greater number of rifled arms; namely that of propelling the projectile and of expanding it into the grooves of the rifle.

There is one subject of importance, to which I must direct your attention, in connection with the repeated firing of a rifled gun; it relates to the solid substances, or residue, obtained on the explosion of powder, particularly in a confined space, such as the barrel of a gun. In the old smooth-bore cannon or small-arms this residue was carried away to a very great extent, on the discharge of the piece, by the sudden rush of gas, so that a cannon could easily be kept clean by the employment of a mop or sponge after the discharge.

But in the case of the rifled gun with expanding projectile, which may be regarded as a close chamber for a short interval after the discharge, (as the projectile, when acted upon by the exploded powder, exactly fits the bore of the gun,) this escape of gas is comparatively speaking greatly retarded, so that the residue is no longer held in suspension and swept out of the gun to any important extent. It is moreover powerfully compressed by the force of the discharge; consequently we find such large masses of residue as those I now hold in my hand, accumulating in the barrel. Its quantity is moreover greatly increased by the charred remains of the cartridge-bag, which, in the smooth-bore gun, is almost entirely expelled on the discharge. It has therefore been a matter of great importance to promote the removal of this residue, so that each discharge should at any rate carry away the dirt or residue left by the preceding one. In cannon, this is very readily effected by the employment of a wad of hemp or some similar material thoroughly saturated with fatty matter, or by the use of a cake consisting of the lubricating material only. Sir W. Armstrong places a lubricating wad between the powder and the projectile; Mr. Whitworth encloses the charge of powder in a metallic case which he closes with a cake of lubricating material. On the discharge of the gun, the fatty matter is in both instances distributed over the whole of its internal surface, and effectually promotes the removal of the residue. Mr. Whitworth's metallic cartridge is removed from the gun after the discharge; by its use he avoids adding, to the residue of the powder, the charred remains of a combustible cartridge-bag, and he also removes, in the case, that portion of the powder-residue which would otherwise be deposited in the breech of the gun.

In the case of rifled small-arms, the use of wads is considered objectionable, except in special instances; the lubricant has, therefore, to be applied to the exterior of that portion of the cartridge-paper which surrounds the bullet. The selection of a suitable lubricating material for this purpose has been attended with considerable difficulty. Tallow was first employed, in admixture with sufficient beeswax to harden it somewhat and to enable it to resist the effects of warm climates. It was found, however, after some time, that the tallow, penetrating the paper, exerted a corrosive action upon the metal. It is well known that when such an action is once established upon the surface of lead it will, under favourable conditions, readily extend into the mass of the metal, the original diameter of which becomes much increased, as the oxide of lead formed combines with carbonic or other acids and water. These bullets [alluding to specimens on the table] were contained in a Shrapnel shell, and they represent the condition in which many others were found after remaining for some time in store. They were all of the same diameter originally. In some of these bullets there is only a small central nucleus of compact lead remaining. This corrosion was undoubtedly established in the first instance by a small quantity of acid matter, derived from the crude corks with which the shells were closed, and which was conveyed into the shell by moisture, penetrating through the cork. The destruction of these bullets has been the result of a very gradual corrosion, continuing for several years. But here are bullets, very considerably corroded; covered in several places with a hard crust of compounds of oxide of lead, whereby their diameter has become so greatly increased that they cannot without much difficulty be introduced into the rifle barrel. These bullets have only been exposed for a few months to the air in contact with a small quantity of fatty matter, such as tallow, which, becoming acid by atmospheric exposure, has established and carried on this corrosive action upon the lead. The difference between the original diameter of an Enfield rifle bullet and that of the barrel only amounts to 0·23 of an inch, and this is diminished to 0·1 of an inch by the paper and lubricant which surround the bullet. You will therefore readily understand how a slight increase in the diameter of the ball, due to the formation on its surface of a hard crust of the products of corrosion, might render its introduction into the barrel difficult or impossible, particularly in active service. It therefore became necessary to replace the tallow-mixture by some other lubricating material which would not affect the bullets injuriously. Just about the time that the disturbances in India commenced, the subject was receiving investigation, and, after very searching trials beeswax was found to be the most suitable material. Though so very dissimilar to the substances generally used as lubricants, its cleansing properties in the barrel of an arm are remarkable; it produces a beautiful glazing or surface upon the metal, which prevents the adhesion of any of the residue. When pure it exhibits no tendency to promote the corrosion of lead nor does it undergo, by long preservation, any change likely to prove injurious to the metal. After the introduction of beeswax it was found necessary to discontinue the use of the ordinary vegetable oils, applied to the lubrication of the beautiful bullet-making machines, as it was discovered that even the minute quantity of oil remaining upon the bullet after it left the machine and had been cleaned, was sufficient to establish a corrosive action upon the lead. Recourse was therefore had to the neutral and permanent lubricating oil prepared by Price's Candle Company from Rangoon petroleum.

The reference which I have made to gunpowder must serve me as a species of connecting link between the subjects just discussed and another of considerable interest—the improvements which have been effected in the method of exploding mines by electric agency.

You are all doubtless aware that voltaic electricity has been successfully applied for some time past to the discharge of mines. The limits of my time will not permit to enter into details with respect to the methods hitherto in use for calling into play the heating powers of the voltaic current to the ignition of powder, which, I may just remind you, are based upon the resistance offered to the passage of a voltaic current through a metallic circuit, by fine metal wires of inferior conducting powers, such as iron or platinum. By the introduction of short lengths of such wires into those portions of the circuit which pass through the charges of powder, the passage of the current will cause them to become heated to such an extent as to effect the ignition of the powder. Although by such, or similar arrangements, one or two mines may be discharged with certainty by the direct application of the current obtained from a battery of moderate power, more extensive and particularly submarine operations can only be effected by the employment of very powerful batteries, and are even then attended with considerable uncertainty. These circumstances, combined with the very great inconvenience and risk of accident attending the transport of the battery and the acids and other materials required to set it in operation, and the numerous points to be attended to in order to ensure the full development and application of the battery-power, have led to the prosecution of numerous experiments in different continental States and in this country, for the purpose of rendering this particular application of electricity more certain and simple. Some successful results have attended the use of the electricity of high intensity obtained by means of the powerful electro-magnetic coil-machines, constructed by Ruhmkorff and others. By their employment, with appropriate fuse-arrangements for effecting the ignition of the charge by means of the spark, the battery-power necessary for firing a number of mines is very considerably reduced. The most perfect of these coil-machines, even when arranged in a form suitable for transport, are, however, very liable to injury, particularly in the hands of those not thoroughly acquainted with the principles and delicacy of their construction. Their employment, moreover, still necessitates the use of a voltaic battery. Although, therefore, these machines doubtless admit of application with great advantage in special cases, they are not likely to be generally substituted for the old arrangements.

In Austria, very important results are said to have been obtained by the employment of frictional in the place of voltaic electricity. A very portable arrangement of a plate-electric machine with Leyden jars and the other necessary implements, and with a small stove attached, to protect the apparatus from the prejudicial interference of damp, has been employed with success in some extensive operations in that country, as many as one hundred charges having been simultaneously fired by its means.

A short time ago I had the pleasure of being associated with Professor Wheatstone in the prosecution of an experimental inquiry into the merits of the different forms of electricity in their special application to the explosion of mines, and some of the results obtained by our investigation of this subject, are, I think, of sufficient importance to merit a brief notice in this Lecture. At Mr. Wheatstone's suggestion, our attention was particularly directed to the application of the electricity obtained by induction from permanent magnets. It was found that, although gunpowder could be ignited by the magneto-electric spark, the explosion of a single charge, by the use even of one of the most powerful magneto-electric machines, could not be relied upon with any degree of certainty. By employing, as a priming material, a gunpowder slightly modified in its composition so as to increase its conducting power, the ignition of one charge, but of one only, was effected with certainty. After trying with no better success, a large number of explosive compositions of a more sensitive character than gunpowder, I at length lighted upon a material which combined the properties evidently essential to the successful employment of the magnet, namely, considerable sensitiveness as an explosive and a moderate power of conducting the current. By its employment as the priming material, in connection with an appropriate fuse-arrangement for the purpose of permanently fixing it in a position most favourable to the proper action of the current, it was no longer necessary to employ a powerful magnet to effect with certainty the explosion of single charges. Here is a small electro-magnetic machine of comparatively low power, of the kind and size employed by Mr. Wheatstone in his smallest portable magneto-electric telegraph instruments. I have connected with it, by means of these two long wires, two small charges of powder, each containing the primed fuse just referred to. You will perceive that, directly the action of the instrument is established by setting in very rapid motion this little arrangement of multiplying wheels in connection with the moveable armature, the charges are exploded. Advantage is taken of the very rapid succession of currents obtained from such an instrument as this, or, better still, of an arrangement of several such electro-magnets, to effect the ignition of a considerable suecession of charges with such great rapidity, that the result is practically the same as though the explosion of the whole number occurred instantaneously. A portable combination of several of these little instruments, such as has readily been devised by Mr. Wheatstone, and is contained in this small box, is all that is, therefore, required, in addition to fuses and connecting wires, for exploding, at the shortest notice, a considerable number of mines. The advantages offered by the use of such an apparatus are very important. With the most ordinary care it is not liable to injury or disarrangement; it is exceedingly transportable and ready for use at any moment, and the soldier requires but very little instruction in its employment. He has only to place the instrument in connection with the mines and the earth by means of these screws, to turn this handle as rapidly as possible, and to depress this key when the signal to fire is given. It will, I believe, be evident to all present that this system is very greatly to be preferred to the plan of exploding mines by voltaic agency.

Before quitting this subject I must just allude to the successful application which has been made of vulcanised india-rubber to the preparation of receptacles for the powder-charges employed in submarine operations. Such bags as the specimen before us are perfectly watertight under very considerable pressure, they are far more easily transportable and generally managable than the wooden or metal vessels which have hitherto been employed for the reception of powder to be exploded under water. This reference to india-rubber affords me an opportunity of directing your attention to the very numerous applications which this invaluable material (especially in its vulcanised form) now receives in connection with military equipment, of which I will only enumerate a few to demonstrate how indispensable it has become in this direction. It is applied to the preparation of waterproof linings for powder barrels and waterproof cases for cartridges, both so essential to the preservation of ammunition in such climates as that of China. These very convenient holders for percussion caps are of india-rubber and the caps which they contain are rendered waterproof with the same material. It is gradually coming into extensive use in the form of springs and buffers in connection with gun-carriages and the beds of heavy mortars, as shown in this model; and ambulance waggons are also supplied with efficient and easily replaceable springs of india-rubber. The general supply now made to troops when on active service, of waterproof clothing, blanket covers and other articles connected with camp equipment, constitutes one of the most important applications of this material and one of the greatest of recent additions to the comfort of the soldier.

I had occasion, in the Lecture delivered here four years ago, to refer to the experiments which were then in progress with the view to protect the wooden camp-huts, first adopted during the late war, from accident by fire, and I described a very cheap and efficient plan which has been adopted for effecting this important object. It consists in coating the wood with a species of artificial stone (a double silicate of lime and soda), readily produced by applying alternately a solution of soluble glass and lime-wash to the surface of the wood. This coating has been found to offer very great resistance to fire and to be very durable when exposed to the effects of rain and cold. Attempts have been quite recently made to afford a similarly permanent protection to tents, by the employment of silicate in some form, which have led to the discovery of a simple process whereby canvas may be throughly impregnated with an insoluble silicate, which protects it to a remarkable extent from fire. You will observe that when I inflame the oil with which the one extremity of this piece of prepared canvas is impregnated, it will only continue to burn until the oil is consumed, and the flame, though it will envelop, for a time, the greater part of the canvas, will not spread beyond the oiled portion. This other piece of canvas, similarly oiled at one end and not protected by the process, will be completely destroyed in a very short time.

Among the services which may be rendered to troops by soluble glass I may also mention its application, by Mr. Ransome, to the construction of these very portable filters of artificial stone, by which all mechanical impurities are readily separated from the water of a muddy pool, for example, which may be the only source of water met with on a long march. A more thorough purification of such water is, however, effected by the use of these small filters, which consist essentially of carbon so prepared as to be firm but very porous. By allowing water to pass slowly through a filter of this kind, the separation of impurities, mechanically suspended, is not the only result attained. The property which porous carbon possesses of retaining and promoting the oxidation of organic matter and of offensive gases (such as sulphuretted hydrogen) which exist dissolved in the water, renders a filter of this description valuable for effecting, at any rate, the partial purification of water, which could not be rendered fit for use by means of the stone- or sand-filter. Such small filters as these will of course, if frequently used, lose their valuable properties after some time; these can, however, be to a great extent restored by very simple treatment.

The regular supply of drinkable and wholesome water to

troops at many of our foreign coast-stations and in positions temporarily occupied in time of war, has, on many occasions, been attended with formidable difficulties, which, in some cases, have been met by the employment, in such localities, of the apparatus introduced by the late Sir Thomas Grant, for the production of fresh water, on board ship, from sea-water, and which has, for some time past, been extensively used in the Navy. The apparatus simply consists of an efficient condenser, whereby distilled water is produced from the steam generated in the ship's or other boilers. The product, which exactly resembles ordinary distilled water, though drinkable, is by no means pleasant, when first obtained; it is entirely wanting in the briskness more or less common to all fresh water, and which is due to the gaseous matter contained in solution. If this water be, however, kept in partially filled tanks for some time and, particularly if, by the motion of a vessel, for example, it be maintained in continual or frequent agitation, it becomes partially aërated and is thus rendered somewhat more palatable. It always possesses, however, the peculiar unpleasant flavour of distilled water, which has been produced from steam generated in metal vessels and which is due to the presence, in solution, of minute quantities of empyreumatic matter resulting from the decomposition of organic substances contained in the water. This flavour may be at once removed by passing the aërated water through a vessel containing charcoal, which absorbs the minute quantities of organic matter and promotes their rapid oxidation by the oxygen dissolved in the water.

By combining the application of this fact with a simple, ingenious and very efficient method of aërating the distilled water, Dr. Normandy has succeeded in effecting one of the most important of recent improvements in the purification of water, and one which has already received several applications in connection with the military service, though its benefits will unquestionably be far more extensively experienced by all branches of the marine service. I cannot attempt a detailed description of Dr. Normandy's apparatus for producing aërated fresh water from sea- or other water, highly charged with saline matters. I will try, however, with the aid of this diagram, to give some idea, in a few words, of its mode of action.

The heat of the steam which passes over from the boiler into the apparatus is made to perform, in succession, two important operations. In the first instance, it is applied to the production of a fresh quantity of steam (equal in volume to that obtained from the boiler); this is very simply effected by employing so small a volume of water for condensing the first steam (which always enters the apparatus under a slight pressure) that the former is speedily raised to a temperature at which it is rapidly converted into steam, and at which it is maintained by suitable arrangements. This second portion of steam is made to pass into another condenser, differing in its arrangement from the first in this, that the condensing water employed in it is very gradually but continuously replaced, so that, though its temperature is not raised to the same extent as that in the first condenser, it becomes sufficiently hot, before it passes out of the apparatus, to part with nearly the whole of the gaseous matter which it contains in solution. The gas thus expelled from the water is made to mix with the steam produced in the apparatus, as described just now, so that the latter, on its condensation, furnishes distilled water, thoroughly saturated with the gaseous matter derived from the original water. This aërated product, in passing into a refrigerator, mixes with the first product, which is simply ordinary distilled water, and the whole then flows through a cylindrical vessel filled with wood-charcoal, from which which it issues as bright and sparkling water, completely free from any trace of the usual flavour of distilled water, and as palatable as the best spring-water. A comparison of this specimen of the usual product, with these samples of spring-water and common distilled water will convince any of my audience that the apparatus which I have endeavoured to describe is not simply an efficient and economical condensor, but that it performs to perfection its functions of aëration and purification. An apparatus of this kind was employed to supply the German Legion with water at Heligoland during the late war; two of large size have been despatched to China for the hospital-ships, and I believe that many cases will occur in which it will be applied with great benefit to the supply of wholesome water to troops.

Though I feel that I have already trespassed unwarrantably upon your time, I cannot conclude without some reference to one other subject most intimately connected with the comfort of troops. At the time of the late war, the general arrangements for the supply of food to troops in barracks and on active service were generally admitted to be very defective in their nature. Captain Grant was the first to direct his attention earnestly to an improvement of those arrangements, and the results of persevering labour in this direction have been the production of very efficient and economical barrack cooking stoves and the invention of a simple and excellent system of cooking in the field. Captain Grant has not only greatly reduced the cost of cooking in barracks, by economising the fuel and applying the waste heat of the fires to the heating of large ovens; he has also reduced the time required for cooking for a large number of men, and has placed it in their power to cook their food in a variety of ways. His ranges have been extensively used at Woolwich, Aldershot and other large stations, and, although, recently, claims have been raised by others to further achievements in the economy of the cooking, there is no question that the merit belongs to Captain Grant of having effected the first great improvements in this direction. His cooking apparatus for the field consists of a number of long cylindrical kettles (which may, if necessary, be made to serve the purpose of pontoons) and which are used in the following manner. Four trenches are dug in the form of a cross, each of sufficient length to receive two kettles placed end to end, and of such other dimensions that the kettles shall be supported by the sides of the trenches, of which the lower portions are thus converted into flues, all communicating with a central sheet iron chimney. The kettles are, therefore, heated by kindling a fire at the extremity of each trench, and with eight of these kettles, arranged in this manner, sufficient food for 800 men can be cooked in about three hours with a very small expenditure of fuel. There are several other points connected with the results of Captain Grant's successful labours for the comfort of troops which I could wish to have noticed, but they must unavoidably be classed with other portions of my story which I have been compelled to leave untold.

The vast magnitude of my subject and the great variety of topics which have presented themselves for discussion will I trust be held as some excuse for the length and the imperfect and fragmentary nature of this discourse. I cannot hope to have done anything like justice to a single one of the subjects of interest to which I have directed your attention, but I shall, at any rate, have attained one object of this Lecture if I have succeeded in presenting you with an outline of the very numerous directions in which the most recent applications of every branch of science are being rendered productive of improvement in the military resources of this country.

CHEMICAL SOCIETY, 3 *May* 1860.

R. Porrett, *Esq. F.R.S. Vice-President, in the Chair.*

Mr. J. A. Wanklyn read a paper *On Zinc Methyl*. This compound has been hitherto prepared by the reaction of iodide of methyl and zinc in the presence of ether. The ether, by its solvent action on the products, enables the reaction to be effected thoroughly, and at a comparatively low temperature. But the resulting zinc-methyl, prepared in this manner, cannot be freed from the vapour of ethyl. The author observes that the purpose for which ether was used might be fulfilled by zinc-methyl itself. Hence he

digested iodide of methyl and zinc with a strong etherial solution of zinc-methyl, whereby he was able to obtain a stronger solution of zinc-methyl. Fresh zinc and iodide of methyl were next digested with this stronger solution of zinc-methyl, whereby a still stronger product was obtained, and this process could be repeated several times. By four successive digestions the author succeeded in procuring from a single tube about half an ounce of very pure zinc-methyl. It was analysed by its conversion into hydride of methyl by the action of water. Zinc-methyl boils between 50° and 60° C. and may be heated in sealed tubes to above 200° without decomposition. Its vapour-density taken at 100° proved to be 3·291, which corresponds with the calculated density for a two-volume molecule, hydride of methyl being taken as a four-volume molecule. Zinc-ethyl combines with iodide of zinc to form a crystalline compound, probably Zn_2,C_2H_3,I.

Dr. Frankland said that Mr. Wanklyn's process was very ingenious, and might be applied, he thought, to the preparation of zinc-ethyl. He had found no difficulty in preparing small quantities of pure zinc-methyl by the first process; but when acting on larger masses in an iron digester only partial union took place. He was ready to admit that the poisonous qualities he once ascribed to zinc-methyl had not been confirmed by his more extended experience.

Mr. G. B. Buckton, F.R.S. read a paper *On the Stibethyls and Stibmethyls.* Taking stibethine $SbEt_3$ to represent the teroxide of antimony, the object of the author was to form ethylic or methylic compounds representing antimonious and antimonic acids, SbO_4 and SbO_5 respectively. For this purpose he prepared the biniodide of triethyl, stibine, $SbEt_3I_2$, by the action of iodide of ethyl upon antimony, and then reacted upon the product with zinc-ethyl, whereby a considerable evolution of heat took place. By distillation a heavy yellowish liquid was obtained, which was rectified in an atmosphere of coal-gas. The great bulk passed over between 150° and 170° C. The fraction that passed over below 160° proved to be triethylstibine. The author verified the description of this compound and of its salts as given by Löwig. The fraction boiling between 160–70° showed a considerable increase in the proportion of hydrogen and carbon. The analysis corresponded with the composition of tetrethylstibine, but the body was thought to be a mixture of triethylstibine and pentethylstibine. Further rectification did not increase the proportion of ethyl, the body being gradually broken up by heat. Bromine, which combines directly with triethylstibine, formed also with this body the bibromide of triethylstibine, but at the same time produced an evolution of hydride of ethyl and ethylene, indicating an excess of ethyl in the compound. Similar experiments were made with the biniodide of trimethylstibine, which was readily obtained by acting upon metallic antimony with iodide of methyl at the temperature of 140° C. This was acted upon by zinc-methyl, the resulting mass submitted to distillation, and the distillate rectified in an atmosphere of coal-gas. Fractions were taken between 80–86°, 86–96°, 96–100°. The first fraction yielded 21·99 per cent. of carbon, the second 26·9, the third 30·18. $SbMe_3$ yields 20·69, $SbMe_4$ 25·39, and $SbMe_5$ 29·46 per cent. of carbon. All three bodies were oily liquids, heavier than water, and not spontaneously inflammable, save when dropped on a warm surface.

Dr. Guthrie read a paper *On some Derivatives from the Olefines.* When peroxide of nitrogen NO_4, prepared by heating nitrate of lead, was passed into a flask containing amylen, it was instantly absorbed, and the amylen converted into a pasty mass of minute crystals, which after purification were analysed, and found to have the composition $C_{10}H_{10}(NO_4)_2$. This body is remarkable as being the first nitro-representative of Dutch liquid, and from its similar mode of formation to that compound. The new body, termed by the author binitroxide of amylen, crystallises in small rectangular colourless plates. It is insoluble in water, sparingly soluble in cold, but readily soluble in hot alcohol. It decomposes when heated to 95° C. Peroxide of nitrogen did not react with ethylen, and with naphthalin formed only nitronaphthaline, $C_{20}H_7(NO_4)$. The author having referred to his former unsuccessful attempts to unite bisulphide of chlorine with ethylen, now showed how the experiment might be successfully performed. He placed a few grammes of bisulphide of chlorine in a well stoppered bottle, which he then filled by displacement with ethylen, and, having secured the stopper, immersed the bottle for twenty hours in boiling water, whereby a very complete absorption was effected. By repeating the charge of ethylen several times, he was able to procure a considerable quantity of the bisulphochloride of ethylen, $C_4H_4S_2CE$. It is a pale yellow coloured liquid of a peculiar smell and sweet pungent taste, and, like the similar compounds previously described, is decomposed by heat.

CORRESPONDENCE.

Epsom Salts or Poison?

To the Editor of the Chemical News.

Sir,—As oxalic acid is sometimes sold by mistake for Epsom salts, I would recommend all vendors of those articles, if they cannot *swear* to what they are selling, to adopt a very simple method of distinguishing between the two, known to every chemist. Let them put a little of the substance into a wine-glass, pour upon it a small quantity of cold water, and add a crystal of protosulphate of iron (green vitriol). In the case of the medicine, no effect will be produced; but in the case of the poison a bright yellow colour will in two or three minutes form in the mixture.

If this plan were generally followed, it might decrease the number of those unhappy "poisonings by mistake" which from time to time appear in the columns of the press.

I am, &c. Thos. Salter, *F.C.S.*

[Perhaps a simpler method of distinguishing between Epsom salts and oxalic acid is heating them over a gas flame on a spatula. The Epsom salts only part with the water of crystallisation, the oxalic acid is decomposed and dissipated. A yet simpler, although not a chemical way, would be to taste a crystal.—Ed.]

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

The Formula of Zirconia and the Fluozirconates.—The formula for zirconia generally adopted is that of Berzelius, Zr_2O_3. M. Marignac[1] however questions the accuracy of the analyses on which it is founded, and adds that it is inconsistent with the properties of zirconia. The formula ZrO, admitted by some authors, has nothing to support it. Recently Deville and Troost have shown, by the density of the vapour, that the formula of the chloride of zirconium must be $ZrCl_2$. On this hypothesis zirconia will be a binoxide, and will range with titanic, stannic, and silicic acids. In his first investigations on zirconium Berzelius remarked that its proper place was by the side of silicium, and he only separated them to follow the division of the elements into metallic and non-metallic bodies—a division still in use, notwithstanding its inconveniences. The relations between zirconia and titanic acid are still nearer; chemists having sought almost in vain a method for the analytical separation of the two bodies, which are often associated in the same mineral.

M. Marignac thought that a complete study of the fluozirconates would decide the disputed question of the formula of zirconia. The fluoride of zirconium forms with most metallic fluorides double salts which are soluble and crystal-

[1] *Comptes-Rendus*, t. l. p. 952.

lisable; the *acidity* of this fluoride, however, is less marked than that of the fluorides of silicium, titanium, and tin. All the fluozirconates, except those of potash and soda, are easily decomposed by prolonged calcination in the air, the fluorine being dissipated in the form of hydrofluoric acid by the intervention of atmospheric moisture. The constitution of these salts leaves no doubt of the necessity of admitting two equivalents of fluorine in the fluoride of zirconium, or, at all events, of the impossibility of supposing three equivalents to enter into the composition. The author investigated the relations between the fluorine of the basic fluoride and that of the fluoride of zirconium, and found that the most common was 1 : 2 or 2 : 4. He finds this also to be the most stable form, and almost the only one which could be dissolved in water and recrystallised without alteration. He takes therefore as the type of the normal fluozirconate the form $MF\ Zr\ F_2$.

From the constitution of these salts the author expected to find numerous examples of isomorphism with the fluosilicates, fluotitanates, and fluostannates, but discovered that it was not common. He only observed it with the fluozirconates of zinc and nickel. M. Marignac gives, in conclusion, a table of the crystalline forms of a variety of fluozirconates, a detailed description of which he intends to give in a more extended memoir.

Analysis of Two Minerals Sublimed in an Eruption of Vesuvius, 1858. — M. Cappa[2] describes the physical properties of these two bodies as resembling those of *cotunnite*, of a dull yellowish colour. A contained chlorine (large quantity), sulphuric acid, silica, lead (large quantity), copper, and sodium. B contained chlorine, lead, and copper. A may be considered as oxychloride of lead mixed with small quantities of chloride of copper and sodium, and with traces of sulphates and silicates. Minerals have already been found having the composition:—

$$PbO.PbCl. \text{ and } {}_2PbO + PbCl.$$

The mineral A seems to belong to the first sort, and the supposition is the more probable when we remember that one process for making oxychloride of lead is to treat lead oxide with chloride of sodium and water; the hydrated oxychloride thus formed becomes yellow by calcination. Lead in contact with chloride of sodium and vapour of water was probably the origin of the above mineral. The product B from its physical and chemical properties may be considered as an oxychloride of lead with a small quantity of cupric chloride.

II. ORGANIC CHEMISTRY.

Chemical Properties of Acetylene. — We have already mentioned (Chemical News, No. 24, p. 287) the discovery of acetylene by M. Berthelot; we now return to its chemical properties as described by the same author.[3] He says they may be condensed into a word by saying that this carbide possesses most of the essential properties of olefiant gas, from which it only differs by two equivalents of hydrogen. It furnishes parallel derivatives by uniting with bromine, sulphuric acid, the elements of water, and lastly with hydrogen. Of the *bromide* of acetylene the author at present says nothing. *Acetylsulphuric acid* is prepared by means of acetylene, exactly as ethylsulphuric acid is by means of olefiant gas — that is by shaking the gas and strong sulphuric acid together for a long time. To effect the absorption of acetylene, indeed, requires a longer time and more shaking than olefiant gas—two pints necessitating an hour's exertions, and at least four thousand shakes. When the absorption is finished the acid is carefully diluted with water, and saturated with carbonate of baryta: on evaporating a well-crystallised salt, *acetylsulphate of baryta* is obtained. If instead of saturating with baryta, the acid be distilled and the product be repeatedly rectified, a liquid is obtained which is a little more volatile than water, is very unstable, and has a smell like acetone, but extremely irritating. It is soluble in 10 or 15 parts of water, is precipitable from its aqueous solution by carbonate of potash, but does not appear to be so by chloride of calcium. The author regards this liquid as *acetylic alcohol*, $C_4H_4O_2$, which differs from ordinary alcohol by two equivalents of hydrogen. The difficulty of preparing acetylene in sufficient quantity has prevented the author from studying the compounds in detail, but he intends to resume his investigations. He concludes for the present by establishing a new relation between acetylene and olefiant gas, founded upon their reciprocal transformation. Olefiant gas and its hydrates furnish acetylene at a red heat: the inverse metamorphosis can be effected at low temperature, by treating the compound which results from the action of acetylene on ammoniacal protochloride of copper, with nascent hydrogen, produced by the action of zinc on ammonia. Under these circumstances a gas is disengaged rich in olefiant gas, but mixed with some hydrogen and a little acetylene. The method employed to develope nascent hydrogen in an alkaline liquor in the presence of an organic compound, the author thinks is susceptible of very extended applications. The acetylic series, he remarks in conclusion, is especially interesting on account of the simplicity of its composition, and by its systematic construction, founded entirely on synthesis.

Compound of Chloride of Arsenic and Alcohol. M. de Luynes describes[4] a compound of chloride of arsenic and alcohol, obtained by distilling a mixture of these two bodies. It is also obtained by passing a current of chlorhydric acid gas through alcohol holding arsenious acid in suspension. The temperature of the mixture rises as the arsenic dissolves, and the liquid soon separates into two layers. The inferior layer when submitted to distillation begins to boil about 96° C. and the temperature continues to rise until it reaches 148° C. where it remains stationary. The liquid obtained is colourless and fumes in the air. Water decomposes it into chlorhydric and arsenious acids and alcohol. The compound has little stability. Moisture rapidly decomposes it. Submitted to repeated distillations it becomes partially decomposed, forming compounds which boil below 148°, and among which chlorhydric ether is found. The formula of the compound appears to be $C_4H_6O_2\ AsCl_3$. Analysis gave:

	Found.		Calculated.
C	9·5	9·6	10·9
H	2·1	2·7	2·3
Cl	47·7	47·6	48·7
As		34·5	34·3

Wood-spirit and potato oil appear to give similar compounds.

Preservation of Ox Gall.—M. Gagnage[5] has found that by adding about ½ per cent. of acetic ether to ox gall, the fluid may be preserved from putrefaction for any length of time. He also proposes to utilise the gall bladders by making soap from them, but in this he was of course anticipated by Mr. Whipple and others years ago.

LABORATORY MEMORANDA.

Reaction of Concentrated Sulphuric Acid on Iodide of Potassium.—When iodide of potassium is treated with concentrated sulphuric acid, a considerable quantity of *hydrosulphuric acid* is evolved together with much hydriodic acid and free iodine. This circumstance, which may deceive an inexperienced analyst, appears to be accounted for by the action of nascent hydriodic acid upon sulphurous acid, a view supported by the following experiments:—

Sulphite of soda treated with strong sulphuric acid does not evolve hydrosulphuric acid, even on adding iodine.

Sulphite of soda heated with excess of hydriodic acid in solution does not evolve hydrosulphuric acid.

Iodide of potassium heated with crystallised oxalic acid evolved simply hydriodic acid.

A mixture of iodide of potassium, oxalic acid, and sulphite of soda evolves hydrosulphuric acid when heated.—*C. L. B.*

[2] *Comptes-Rendus*, l. t. p. 955 [3] *Ibid.* p. 860.

[4] *Comptes-Rendus*, p. 831. [5] *Moniteur Scientifique*, No. 81, p. 688.

MISCELLANEOUS.

The Magnesian Light.—Magnesium is well known as the metallic basis of magnesia; it is much lighter than aluminum, as its specific gravity is only 1·74; it is of a silvery whiteness, undergoes no change in dry air, and is subject to but slow oxidation in a damp atmosphere, and that only quite superficially; it may be hammered, filed, and drawn into threads. At the beginning of the present century its properties were developed by Davy, and still more thoroughly by Busse. To obtain it pure is an expensive process; and as no practical advantage could hitherto be made of it, no one had attempted to discover a cheaper method of getting it. It was reserved to Bunsen to perceive a new property in this metal, and to suggest a practical application of it. Magnesium takes fire at the temperature at which glass melts, and burns with a steady and extremely vivid flame. In some photo-chemical investigations by Bunsen and Roscoe, experiments were made to test the illuminating capacity of a magnesium thread, when Bunsen discovered that the splendour of the sun's disc was only 524 times as great as that of the thread. Bunsen also compared the magnesium flame with ordinary lights, and found that a burning thread of 0·297 millimetres diameter produces as much light as 74 stearine candles, of which five go to the pound. It is plain that it only needs a mechanical device to spin magnesium when heated into the form of a thread upon spools, from which they can be run off like the strips of paper in Morse's telegraphic apparatus, to render it of practical use. Such a magnesium lamp-wick would be far more simple and complete than the preparations for the use of the electric or the Drummond light. A spool with its thread, a clock-work to wind it off, with the spirit lamp, would be easily transportable. A rival, therefore, to the strong lights hitherto used is like to spring up in Bunsen's magnesium-lamp, in all those cases where the item of expense is likely to be slightly regarded, for example, in brilliant illuminations, light-houses, &c., for extraordinary degrees of illumination may be obtained by burning several of these threads of large dimensions at once.—*Engineer.*

Can Frogs live in a Stone?—In 1852 M. Séguin enclosed twenty frogs and snakes in mortar, in order to decide the question whether it was possible for them to live entirely deprived of air. In course of time most of the blocks of mortar were lost, but two which remained were opened last week in the presence of a committee of the Academy of Sciences of Paris. A viper was found in one and a frog in the other—both dead and dried up.

The Instinct of Appetite.—Chemical analysis and physiological research have established beyond dispute, that every article of food and drink is composed of elements differing in quantity or quality. It is equally true that the various parts of the human frame are different in their composition, as the bone, the flesh, the nerve, the tendon, &c. But there is no element in the human body which is not found in some article of food or drink. A certain normal proportion of these elements, properly distributed, constitutes vigorous health, and forms a perfect body. If one of these elements be in excess, certain forms of disease manifest themselves; if there is not enough, some other malady affects the frame. When the blood contains less than its healthful amount of iron, it is poor, watery, and comparatively colourless; the muscles are flabby, the face pale, the eyes sunken, the whole body weak, the mind listless and sad. If the bones have not enough lime, they have no strength, are easily bent, and the patient is rickety; if there is too much lime, then the bones are brittle, and are broken by the slightest fall or unusual strain. The highest skill of the physician in these cases consists in determining the excess or deficit of any element, and in supplying such food or drug as will meet the case; when the medical attendant cannot determine what is wanting nor furnish the supply, nature is often loud enough in her calls, through the tastes or appetites, to indicate very clearly what item of food or drink contains the needed elements; this is the "Instinct of Appetite." Chemistry is unable to say of but one article of human food, that it contains all the constituents necessary to supply the human body with every element requisite for its welfare, and that is pure milk, as supplied by the mother of the new being; but after the first years of life, the body demands new elements, in order to enable it to meet the duties which increasing age imposes; hence, nature dries up this spring, as being no longer adequate, and compels the search for other kinds of sustenance, showing that milk is a proper sole food for the young ones; and healthy grown persons who live upon it mainly will always become invalids.

All kinds of life, whether vegetable or animal, have within them a principle of preservation as well as of perpetuity; were that not the case all that breathes or grows would die; this principle or quality is common to man and beast and all that springs from root or seed; it is named "Instinct." It is instinct which calls, by thirst, for water, when there is not fluid enough in the system. It is instinct which calls for food, by hunger, when a man is weak and needs renovation. It is curious and practically valuable as a means for the removal of disease, to notice the working of this instinct, for it seems to be almost possessed with a discriminating intelligence; certain it is, that standard medical publications give well-authenticated facts showing that following the cravings of the appetite, the animal instinct, has accomplished far more than the physician's skill was able to do; has saved life in multitudes of cases, when science had done its best, but in vain.

Prophylactic against Hydrophobia, by Dr. Petit.—As soon as an individual is bitten by an animal supposed to be mad, he ought to wash the wound and neighbouring parts with ammonia or boiling milk, and continue the washing for at least three days. (A footnote informs us that the Dr. prefers to cauterise the wound either with the actual cautery or sulphuric acid.) At the same time the patient should take every morning fasting for nine consecutive days, a glass of the following decoction, warm:—

Angelica root (in powder)	30 grammes.
Gentian root "	30 "
Venice treacle	30 "
Assafœtida (well crushed)	15 "
Oyster shells (in powder)	15 "
Sweetbriar root	40 "
Root of viper's grass (unscraped)	40 "
Rue tops (fresh) } Sage (chopped fine) } Sea salt }	of each ½ a handful.
1 clove of garlic.	
3 leeks with the beards.	
2 small onions.	
Daisies, a pinch.	

Boil all together with three litres of red wine of the best quality possible in a covered pot until reduced to half, then express and strain. The decoction may be kept for nine days in closed bottles. Delicate and weak patients sometimes vomit the first doses, but the stomach soon becomes accustomed to the curious mixture. For children under 10 the dose is only half a glassful, and for those between 10 and 20 three quarters.—*Répertoire de Pharmacie.*

[The above is a curious prescription for a physician to write in the 19th century. After an immediate cauterisation we have no doubt it would be a very useful medicine, but not otherwise.—Ed.]

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A Student.—The subject will receive our early attention.

C. G. Smith.—*G. D.*—Received with thanks.

B. A. M.—It is our intention to give a very full abstract of the Lecture in an early number.

J. A. D.—The Journals alluded to were the two Philosophical Magazines.

P (Cambridge)—We will give extracts from the Tables next week.

W. P.—Try a moderately dilute mixture of hydrochloric and oxalic acids.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E. C.

Advertisement.—Poisoning by Photographic Chemicals.—The *British Journal of Photography*, for June 1st (price 3*d.* free by post 4*d.*) Contains an elaborate Table of Antidotes to the Poisonous Bodies used in Photography, (drawn up from the most recent medical authorities), by Samuel Highley, F.G.S. F.C.S. This important Table will be reprinted on cardboard, with convenience attached for hanging up, in order that it may find a permanent place in every photographer's studio and chemical laboratory. The price will be 6*d.* This number of the *British Journal of Photography* also contains numerous other important articles by writers of acknowledged ability, critical notices, meetings of photographic societies, interesting home and foreign correspondence, &c.

Liverpool: Henry Greenwood, 32 Castle Street; London: E. Marlborough and Co. 4 Ave Maria Lane. May also be ordered through the Agents and Booksellers.

THE CHEMICAL NEWS.

VOL. I. No. 28. — June 16, 1860.

PHARMACY, TOXICOLOGY, &c.

Notes on some of the Chemical Reactions of Atropine, by T. G. WORMLEY, *M.D.*

ATROPINE, as is well known, is the active principle, or alkaloid of *atropa belladonna*, or deadly night-shade. The crystallised alkaloid dissolves in concentrated nitric acid, without any change of colour upon heating the solution, and after cooling, the addition of a drop of chloride of tin solution gives a copious white deposit; without heating, the tin salt produces no change. Concentrated sulphuric acid dissolves it with a very slight yellow colour, and the addition of nitrate of potash yields no change.

In the following experiments crystallised atropine was dissolved by the acid of acetic acid:

I. Tannic Acid. — 1. 100th grain of atropine, in one grain of water, gives, with tannic acid, an immediate dirty white precipitate, readily soluble in potash.

2. 1000th, an immediate bluish precipitate.

3. 2500th, gives a very good precipitate.

4. 5000th, after several minutes a just perceptible cloudiness.

II. Terchloride of Gold. — 1. 100th, gives a copious light yellow precipitate, readily soluble in excess of acetic acid.

2. 1000th, an immediate greenish yellow precipitate.

3. 2500th, gives much the same as 2.

4. 5000th, no indication.

III. Bichloride of Platinum. — 1. 100th, gives a pretty good dirty yellow amorphous precipitate.

2. 500th, no indication.

IV. Carbazotic Acid. — 1. 100th, gives an immediate light yellow amorphous precipitate, which dissolves in a few drops of acetic acid.

2. 1000th, in a few seconds a light greenish precipitate, which after a little time is quite copious.

3. 2500th, after several minutes, no satisfactory indication.

V. Iodine in Iodide of Potassium. — 1. 100th, gives an immediate copious brownish amorphous precipitate, which completely dissolves in a few drops of a strong solution of potash.

2. 1000th, a good brownish precipitate, insoluble in acetic acid.

3. 10,000th, much like 2.

4. 20,000th, an abundant red precipitate.

5. 30,000th, at first a yellowish, after a little time a very good red-brown precipitate.

6. 100,000th, gives a very satisfactory precipitate.

7. 500,000th, still perceptible.

VI. Bromine in Bromohydric Acid. — 1. 100th, gives an immediate copious bright-yellow amorphous precipitate, which soon becomes a mass of twig-like crystals. If there be deficiency of reagent used, the precipitate will dissolve, but is reproduced upon the farther addition of reagent. The precipitate is insoluble in potash solution.

2. 1000th, an immediate yellow precipitate, insoluble in acetic acid.

3. 10,000th, gives an immediate greenish-yellow crystalline precipitate.

4. 20,000th, much like 3.

5. 50,000th, no satisfactory indication.

The reaction of the above reagent is quite characteristic, it being the only one that will give a distinct crystalline precipitate with atropine; whereas, with most if not all the other alkaloids, the reagent gives an amorphous deposit.

VII. Potash. — 1. 100th, gives a good white amorphous precipitate, which readily dissolves in much excess of the reagent.

2. 500th, gives no indication.

Ammonia behaves about the same as potash; however, the precipitate is more soluble in excess of ammonia than in potash.

With a solution, holding 100th of its weight of atropine, neither of the following reagents will give a precipitate: — gallic acid, iodide of potassium, sulphocyanide of potassium, chromate of potash, chloride of mercury, ferro, nor, ferri-cyanide of potassium, acetate of lead, nor chloride of barium.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. ANSTED, *M.A. F.R.S.*

LECTURE I. *The Surface of the Atlantic.*

I HAVE proposed as the subject of a course of lectures to give an account of some recent researches in Physical Geography and Geology. In doing this, as you may conclude from the printed syllabus in your hands, I have no intention of connecting the different lectures in any other way than by the general relation they all have to one department of science, and in each lecture — although in the present one least of all — I shall have to bring before you some very recent researches and their results, which are, I think of no trifling interest.

On the present and the next succeeding occasion an account of the successful efforts that have been made to determine the physical geography of a great sea and the conditions of its depths, will show how near we are to a successful and permanent effort to secure telegraphic communication with America. Afterwards I shall hope to present several recent discoveries concerning the interior of Africa and Australia with sufficient clearness to connect the configuration of those remarkable lands as now known with ascertained geographical conditions elsewhere. Africa and Australia will thus help to illustrate the Atlantic sea bottom. Recently acquired statistics of those remarkable subterranean movements which we call earthquakes, and their relation to volcanoes, together with an account of the probable origin of volcanoes, are subjects that will occupy us for an hour each, were it only in reference to the form of continents, and the method of their natural drainage by large rivers, in further illustration of the structure of Africa and Australia and of the ocean floor. The

subjects of these five lectures are very closely connected. The next subject is more practical. It refers to a subject of no trifling interest to all of us at the present time. The two last lectures will refer to matters — one also practical, in reference to the great laboratory of nature, and the last involving questions of great interest to the archæologist and historian, as well as to the geologist. Different from one another and from the first group as these three last subjects are, they agree in this — that they all represent the onward march of various divisions of the great army of facts and conclusions which make up the forces of scientific discovery in geological science: — one is descriptive, another theoretical, — one is observed, another deduced, — one is more in the department of geography, another of chemistry, but all belong to natural history, in the wide and philosophical sense in which that term is now employed.

But I must not detain you with general remarks. My lecture this afternoon is on the Atlantic Ocean, and if I merely enumerate some few of the principal phenomena of that ocean you will see how needful it is to waste no time. I must speak of its dimensions and proportions; its coast line, its greater and smaller tributary seas, and the rivers that pour their waters into it; its islands, its shoals, and its depths; the motion of its waters, whether the tidal wave or the great permanent waves and currents by which it is affected; the winds and storms that blow over it; its colour, its temperature, its mineral contents; its permanent and floating ice; its flora and its fauna. Such are the phenomena. Volumes may be and have been written on any one of them. My object must be to communicate a word-painting of those which are most instructive, about which least is known, of which the interest is freshest.

The ocean may be studied at its surface or beneath. To day let us confine our descriptions to the surface, that in the next lecture we may better understand its mysterious depths. Thus, in confining ourselves to the surface, we will first take its dimensions. In order to understand its dimensions, I may refer you to the diagram suspended here, and also to the globe which is before you. The globe will give the idea which I wish to communicate more perfectly than the diagram, but the diagram will be better seen at a distance. Looking at either, it will be observed at once that the Atlantic Ocean, as a body of water, is very different from the form of the other great ocean — the Pacific. The Pacific you will observe to be on a very much larger scale; the Pacific covers as much as three-fifths of the globe, while the Atlantic ocean, although very large, occupying as much area as Europe, Asia, and Africa together, and its dimensions being about twenty-seven millions of square miles, is yet very much smaller than the Pacific, and differs from it in many very important ways. It is long in comparison with its breadth, and if you measure its length from north to south, excluding the latitudes within the arctic and antarctic circles, and all that part of which is south of Cape Horn, you will still have a length of seven thousand miles, whereas the breadth is nowhere more than four thousand, in most parts only two or three thousand, and at one part only one thousand miles. In the Pacific Ocean that is not the case. The form of the Pacific also is different, being much more oval. The Atlantic thus gives one an idea of a canal or trough connected with the Pacific which is the great ocean. It communicates with it, indeed, both northward and southward; southward by the Cape of Good Hope and the Antarctic Ocean, and in the north by a much narrower channel only determined recently at great effort and cost of human life. The discoveries of the Arctic Seas have proved that there is water communication between the Atlantic and the Pacific Oceans, but this has been shown long ago by the fact that whales that have been harpooned in the Atlantic have sometimes been taken in the Pacific. This is certain, owing to the habit of whalers to mark their harpoons, so that the ship and even the date being marked in more than one case, the date of harpooning and that of capturing have been so near as to prove that the open water communication must be also very near, the whale requiring to come very often to the surface to breathe, and therefore not being able to exist for any period under ice. The Atlantic, then, is a trough one thousand miles wide in the northern part, four thousand in the widest part between the coast of Africa and the islands of the West Indies, and then less wide as far as the latitude of the Cape of Good Hope, and it covers about twenty-seven millions of square miles. The indentations on the coast of the Atlantic are remarkable, and the greater part has the land on each side shelving down rather gradually. In my next lecture I shall show you that this shelving down extends to a considerable distance out beyond the actual land, therefore it is a real phenomena in more senses than one. It is sufficient to point out now that the larger part of the land on the Atlantic is generally low, and that on the Pacific it is generally high. The shores of the Pacific are very little indented, and the shores of the Atlantic very deeply. The Atlantic includes a very considerable number of inland seas, gulfs, and bays, characteristic in a very marked way. I mention these points because a great deal of the civilisation and progress of man depends more upon facts of this kind than we are in the habit of thinking. Taking, then, the comparatively low ground which encloses most part of the Atlantic, and connecting it with the form of the inland seas, we shall see that those seas are all mere indentations of the coast. The inland seas are numerous and large. Let me direct your attention to those which are best known. Beginning at the northernmost part of the Atlantic, you find the Baltic Sea eating deep into the European land on the one hand, and Hudson's Bay and Baffin's Bay eating still more deeply into the land on the other side. These two American bays occupy as much as a million and a half of square miles, and when you compare them with the land near them, you will see how important they are. Passing these, passing southwards, we come to that most important indentation of the whole earth — the Mediterranean Sea, whose shores from the earliest period of human history have been the seat of civilisation. This sea was found to be not too large for the early experiments in navigation, and afforded an easy access to numerous coasts. It is divided into two parts: the eastern part extending northward into the Black Sea, and the western opening into the Atlantic. The Mediterranean, although so exceedingly important, is not so large as some of the seas in the Atlantic. It occupies about a million of square miles. On the other side of the canal, in somewhat lower latitude, we have the Gulf of Mexico and the Caribbean Sea, together occupying an area of about two millions and a quarter of square miles (I speak throughout of ordinary statute miles not geographical miles), and these two seas are almost separated from each other by Cuba and Santo Domingo. From them there is a remarkable chain of islands which almost close the Caribbean Sea, and there is a small group of islands, or rather reefs, known as the Bahama reefs, extending northwards parallel to the coast of Florida. Besides those there are several important gulfs. The Bay of Biscay is one, and the Gulf of Guinea is another. Then, again, with regard to the islands of the Atlantic. The Atlantic is not remarkable for what are called oceanic islands. Islands are of two kinds — those which belong to the continent near which they are, and those which are far away from other land. Of continental islands there are some important, like our own, and some others less important, such as Newfoundland. Of the West Indies, the largest may be considered connected with the Continent. This is the case also with Spitzbergen. The Cape de Verde, the Azores and the Canary Islands are oceanic, but if you compare those islands with the great groups of islands in the Pacific, you will find that in the Pacific the islands are of primary and here of secondary importance. I need not name them now, but I direct your attention to them as points of difference.

Then, again, there are shoals, two of them of importance; the great bank of Newfoundland which is of importance

inasmuch as it affects the waters of the ocean, and the Agulhas bank. These are the two principal banks of the Atlantic. I need not say that very large and important rivers empty themselves into the Atlantic. Indeed almost all the principal rivers of the world do so except the Ganges and some in China. In all nearly fifty principal rivers empty themselves in this way. A very much larger portion of the drainage of the land empties itself into the Atlantic than into the Pacific or the Indian Ocean. Next let us consider the regulated motion of the waters of the Atlantic. This regulated motion is produced in three ways, partly by the wind, partly by the tides, which I shall speak of presently, and partly by what are called marine currents. These are three different ways in which motion is produced in the waters of the Atlantic. With regard to winds, I do not mean to enter into the meteorological question, but I must say a few words with regard to them. Winds are by no means so irregular as we are in the habit of thinking. Winds at a certain height above the surface of the earth are probably very regular everywhere, but there are also large tracts of ocean where the same winds prevail during the greater part of the year at the surface. With regard to the winds at high elevations the recent investigations of Mr. Piozzi Smyth on the Peak of Teneriffe have shown distinctly the nature of these remarkable upper currents of air which cross the general direction of the lower currents, and are far more steady. A little to the north of the equator there is a belt of considerable width, not large as compared with the other tracts, during which the wind is scarcely ever to be depended upon, and is very frequently calm. Within the belt the currents of air are very irregular, and for some reason it is called by sailors the *doldrums*. To the north and south of this region of calms are the regions of the trade winds blowing pretty constantly to the north-east on the north side of the doldrums, and to the south-east on the south side. The trade winds on the south side are more regular than those on the north side, where they frequently shift to a considerable extent so that very often they cannot be depended upon. To the north of the belt of trade winds near the tropic of Cancer, there is another belt where the winds are very variable, and this is the case south of the trades about the tropic of Capricorn. There are also to a certain extent regions of calm with occasional storms. At a considerable elevation above the surface in all parts the winds are more steady than upon the surface. Taking the trade winds as great facts in nature it is easy to see that their effect on a great ocean will be considerable. It is impossible that wind can constantly blow on the surface of water without raising the water in the direction towards which the wind blows. Thus the wind raises the waters on the western side of the Pacific, so that the level of the water must be to some extent disturbed, the water on the east side of Africa being higher than it would naturally be. In the Atlantic Ocean itself something of the same kind occurs though in a smaller way, and thus there is a tendency to produce a westerly current, and as we know waters will always find their level, there must be a counter current, and thus the general result of the blowing of the winds is to produce an oceanic current. Besides the trade winds there are storm winds, which, when their course is traced and mapped down, are found to range over the very same sea and over the same tract of land time after time. The course of a great storm on the Atlantic is marked on the map before you, and is, as you may observe from the tropics round the north-east side of the West Indian Islands, then along the east side of the Bahamas, parallel to the coast of America for some distance, but soon crossing the Atlantic nearly in the direction of the British Isles. Some of these storms are very destructive, others not so important, but they most of them recur at fixed periods of the year, and with a certain amount of periodicity. Similar storms are also occasionally met with crossing different parts of the land. These, like the others, consist of spiral currents produced by the rushing on of the air into a vacuum with a circular motion. A storm of this kind took place in the autumn of last year; it was in such a storm also that the deplorable wreck of the Royal Charter took place. In these storms a vast amount of mischief was done on land, and in one instance a striking result was observed in the neighbourhood of Bristol, where a large number of trees were blown down along a very distinct line of narrow width, and these trees were blown down in various directions. Trees not very far from each other were blown down one to the north and one to the south during the progress of this storm. I remember very well in Cuba being told another fact relating to such storms: one of the public buildings in Havannah was destroyed, and the walls were thrown down, but the windows of adjacent houses, instead of being blown in by the force of the storm, were positively blown outwards, as if to fill up the vacuum. This result is not perhaps very usual, and it can only happen in the centre or axis of the storm. Storm winds also produce a great amount of motion in the water. Besides there are the tidal waves and currents produced by them. The tidal wave, you are probably all aware, is the lifting of the water under the moon in its revolution. The waters that cover the earth are separated from the mass of the earth itself, because the water is more movable. Suppose a person standing before a large globe, thus occupying the position of the moon in reference to the earth; the water if tending to come towards that person would bulge from the hemisphere opposite to him, and the earth itself being slightly pulled in the same direction would leave the waters apparently bulging on the opposite side, but the water all round the intermediate parts would be depressed. It would then be high water nearest that person and furthest from him, and low water at intermediate places. The tidal wave is about two feet water or less, the measure is not exactly known, and the motion—not the water—will follow the motion of the moon at about 1000 miles an hour. Not the water but the motion follows the moon, and this motion is simply the wave motion, an up and down motion entirely distinct from the transmission of the water itself. When, however, the tidal wave gets into a small sea, then it exhibits a marked mechanical effect, for it is carried on a long way before it can attain its rest, and the motion in this way carried along the trough of the Atlantic produces, in the various parts of the indentations I have described, the phenomena of tidal waves, having great mechanical force as waves of translation. Thus the tidal wave rushes on up the Bristol Channel, at such a rate as to carry everything along with it producing a great amount of mechanical force. This is entirely the result of the form of the enclosed trough or canal through which the motion is made to pass, and in this way it is that the motion which was simply an up and down motion becomes combined with a forward motion, and in that case it produces mechanical effects.

(*To be continued.*)

Chemical Society. — The next meeting of this Society will take place on *June* 21, when the following papers will be read: — Dr. Lyon Playfair, C.B. F.R.S. "*On Baudrimont's Protosulphide of Carbon*," Dr. Roscoe "*On the Composition of Diluted Acids of Constant Boiling Points.*"

CORRESPONDENCE.

Economy of Sulphur.

To the Editor of the Chemical News.

Sir,—I observe a letter from Mr. C. G. Smith, in your impression of 2nd instant, calling attention to the very great loss of sulphur emanating from the present mode of sulphuric acid and alkali manufacture. This loss is no new idea. Many and oft have been the trials and experiments made by men of not merely theoretical but thoroughly practical ideas, with as yet but little success towards the accomplishing its

recovery. Hundreds of pounds have been spent in such experiments. Years ago some approach was supposed to have been made towards the desired end by the decomposition of common salt without the intervention of *liquid* sulphuric acid, by the process well known as Longmaid's, but with what success the shareholders of a manufactory established for the purpose of working the patent could, I believe, best *feelingly* answer; and if I mistake not the manufactory in question is now worked, in part at least, on the old process of making sulphuric acid in leaden chambers.

If Mr. Smith will look over the patent list he will find numerous suggestions by which to save or recover the sulphur; but how few of them have even paid the expenses incurred in taking out the said patents! Even of recent date it may be noted that a Mr. Spencer and a Mr. Arrott have been experimenting on the subject, and their chief method would appear to be the *recovery* of sulphur by the intervention of a ferric oxide. Time will tell whether these gentlemen have been more successful than their predecessors.

I do not write this with any view to discourage Mr. Smith in his attempts to solve the hitherto difficult question. On the contrary, I am as well convinced as he can be that some day or other the high prices of sulphur, whether obtained from Sicily as such, or from Huelva in Spain, or Wicklow in Ireland, as pyrites, must soon bring to bear upon the subject such a weight of opinion from our *thinking men* that a mine of wealth will be opened up to us at our very doors, by showing a real practical method of saving the present very great loss of sulphur. Mr. Smith should, however, not forget that practice and theory are sometimes widely different. Let him show that he has some day hit upon a *workable* method of accomplishing the desired end, and he will not find manufacturers averse to give him opportunity to put it in practice. Plenty of working chemists will show him how to do this in the laboratory, even to the point of approaching theoretical correctness; but let the thing be tried on a scale where it has to be put in the hands of workmen, and where pounds, shillings, and pence form a somewhat important consideration, and he will find it presents a somewhat different aspect. However I say to Mr. Smith, *nil desperandum!*

I am, &c. A. A.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

The Liquefaction of Gases.— MM. Drion and Loir have suggested[1] a new method of obtaining gases in the liquid state, which consists in hastening the evaporation of certain liquids by the introduction of a minutely divided current of air. We have no description of the apparatus, so we can only give the results announced. The sudden evaporation of ether produces −34° C. of cold, which suffices for the liquefaction of sulphurous acid. The evaporation of liquid sulphurous acid produces −50° of cold which liquefies ammoniacal gas. Liquid ammoniacal gas instantaneously vapourised gives −65°, which will liquefy carbonic acid, and carbonic acid vapourised in the same way gives −87° of cold. By means of the cold produced by the evaporation of ether the authors liquefied the carbonic acid obtained by heating bicarbonate of soda in a sealed tube; and they proved that when the action of the cold was discontinued, the acid recombined with the soda. They also proved that at very low temperatures chemical combinations did not take place, for instance, at −67° sulphurous acid did not unite with ammonia. The Abbé Moigno recommends the authors to ascertain at once whether or not carbon is soluble in carbonic acid as sulphur is in sulphide of carbon. A German philosopher has said that it is, and is occupying himself with the search for diamonds in that direction.

II. ORGANIC CHEMISTRY.

On the Glucosic Fermentation of Cane Sugar.— Under the influence of yeast cane sugar first changes into an uncrystallisable sugar which has an opposite rotating power to the original body, and hence has received the name of "inverted" sugar. M. Berthelot[2] has engaged himself with the study of this phenomenon of inversion, in order to discover what is its precise nature — whether it is due to a special action of the yeast rendered necessary because cane sugar of itself is not directly fermentable, or whether it is the result of some secondary influence independent of the direct action of the ferment. These questions, he says, are extremely interesting, for the answers will show whether yeast produces several consecutive effects on cane sugar or only one — whether it represents several ferments able to bring about various results, and lastly, whether some of the effects which it produces are the same as those caused by contact with dilute acids. M. Berthelot has made experiments in three directions. In the first place he endeavoured to find out whether succinic acid employed under the same circumstances as during fermentation was capable of producing the inverted sugar; and he finds that it has not the power. In his second experiments, he conducted the fermentation in an alkaline liquor, which entirely excluded the influence of an acid, and he found the inversion was produced. These experiments having proved that the change is solely due to the yeast, the author set himself to isolate, if possible, the glucosic ferment, and study its action separately. He digested yeast (which had previously been pressed) with twice its weight of cold water for some hours and then filtered. On mixing the filtered solution with an equal volume of alcohol a precipitate of white flocculi was obtained, which being washed with alcohol and dried at the ordinary temperature yielded a yellowish horny mass. This mass constitutes a particular azotised principle which may be compared with diastase and pancreatine, and which is coagulable by heat on nitric acid. Once isolated it may be redissolved in water and reprecipitated by alcohol again and again, but its activity as a ferment appears to be weakened by the treatment. In its original state, says the author, one part suffices to change from 50 to 100 parts of cane sugar—a rather wide difference for a scientific result. Believing with MM. Cagniard de Latour and Pasteur that yeast is formed of a mycodermic vegetable, M. Berthelot thinks that this vegetable does not act on sugar directly by virtue of a physiological act but by ferments which it has the property of secreting, just as germinating barley secretes diastase, almonds emulsine, the pancreas pancreatine, and the stomach pepsine. Among the several ferments secreted some are soluble and may be isolated, among which is the glucosic ferment; while others are insoluble and remain inseparably combined with the organised tissues of the plant.

[1] *Cosmos, Liv.* xxii. 1860, p. 105.

[2] *Comptes-Rendus*, t. l. p. 980.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

P.—Twaddle's Hydrometers are those generally used by manufacturers for estimating the strength of saline solutions. The degrees on the scale are 0·005 of the specific gravity, which is found therefore by multiplying the number of degrees by 5 and adding 1000.

R. J. R.—Bowman's Analytical Chemistry.

Want of space compels us to defer several answers until next week.

☞ Reading Covers have been prepared for preserving the numbers of the Chemical News until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

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THE CHEMICAL NEWS.

VOL. II, No. 29. — June 23, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Determination of Silver, by FREDERICK FIELD.

(*Continued from Vol. I. p. 277.*)

IT was remarked in the former paper upon the Determination of Silver (CHEMICAL NEWS, Vol. I. p. 277), that the process originally proposed by M. Gay-Lussac, although excellent in the examination of bullion, could not be adopted in the investigation of silver minerals. About two years ago I was trying a series of experiments, not only upon silver in its various native combinations, but also when it existed as an alloy in coins, ingots, &c. The method adopted was based upon the observation that iodide of starch is immediately decomposed by a solution of any silver salt, and the results obtained were so satisfactory and conclusive that I was preparing a memoir upon the subject, which was only withheld from publication on account of my obsersing in a new edition Domeyko's *Tratado de Ensayas* that the idea had been anticipated by M. Pisani, who a short time previously had been engaged upon the same investigation. The *modus operandi* pursued by that chemist and myself certainly differed in many respects, but the methods were essentially the same. M. Pisani remarks[1] that iodide of starch, poured into solutions of various salts, is decolorised in some cases, whilst in others it retains its blue colour. The decolorisation is produced by silver, mercury, and the protosalts of tin, antimony, arsenic, iron, and manganese, as well as the perchloride of gold. The salts of lead and copper have no action upon it. When most of the metals enumerated above are fully oxidised no decolorisation takes place; thus arsenious acid destroys the colour, whilst arsenic acid produces no effect. M. Pisani further asserts that iodide of starch is the most sensitive reagent for detecting silver, providing mercury is not present. Thus it is sufficient to add $\frac{1}{2}$ of a cubic centimetre of iodide of starch to 100 cubic centimetres of a liquid containing $\frac{1}{10}$ of a milligramme of silver to cause immediate decolorisation, although the same quantity of solution gives a very perceptible colour to 100 cubic centimetres of pure water. Although protosalts of iron are mentioned by M. Pisani as decolorisers, I observed that the solution of the protosulphate of that metal had very slight action even upon a very weak solution of iodide of starch. In order therefore to estimate the amount of silver in any compound, a standard solution of the iodide of starch was dropped into the solution of the silver compound until the last drop was undecomposed, and caused a blue tint to remain in the liquid. In testing the presence of silver in samples of commercial lead, M. Pisani dissolved the metal in nitric acid, saturated the excess of acid with carbonate of lime, and after cooling added the iodide of starch. Instead of forming a standard solution of this compound, another method was adopted in my experiments. A solution of iodine in iodide of potassium was prepared, and cautiously dropped into the silver salt, to which a little starch-water had been previously added. The silver compound was dissolved in nitric acid, gently evaporated nearly to dryness, a slight excess of carbonate of soda introduced, and the carbonate of silver brought into solution by very weak acetic acid. A few drops of clear starch-water were added, and the iodurette iodide of potassium dropped from a burette. When the two liquids met a bright blue ring was formed, which immediately disappeared upon agitation, yellow iodide of silver being precipitated. When a permanent blue tinge was produced, no more silver existed in solution. In this process it is not imperatively necessary that all traces of chlorine should be absent. It is better, if possible, to avoid its presence, as the operation then proceeds more rapidly and satisfactorily, but chloride of silver is completely decomposed by iodide of starch, iodide of silver being formed. Thus, if to a liquid rendered opalescent by chloride of silver in a minute state of division, and also containing starch in solution, free iodine be added, a momentary blue colour is produced, which gradually disappears as the chloride is becoming converted into the iodide. Nothing can be simpler than this process. The deep blue colour in contrast to the pale primrose tint of the iodide of silver being very apparent and striking. Although admitting the excellence of the method of estimating silver by means of chloride of sodium, it certainly appears to me that the sudden formation of a dark colour as indicative of the conclusion of the experiment is preferable to the non-appearance of a light white cloud in a colourless solution, as an intimation of the same result. Many trials were made upon the silver coinage of Chili, which is presumed to contain 90 of silver to 10 of copper. The results were in every case most satisfactory. Three burettes were generally employed in the first one, each division corresponded to $\frac{1}{10}$ of a grain of silver, in the second to $\frac{1}{100}$, and in the third to $\frac{1}{1000}$. When it was evident that the greater part of the silver had been precipitated by the solution from the first burette, a small quantity from the second was introduced, and the last traces were thrown down by the third.

Many minerals were also experimented upon. No difficulty was experienced in lead ores, nor in the poorer varieties of those of copper; when, however, this metal existed in abundance the solution itself was of so dark a tint that the permanent appearance of the iodide of starch could not be recognised. Tribasic sulpharsenite of silver ($3AgS.AsS_3$) was dissolved in strong nitric acid and the silver estimated most successfully, although the sulphantimonite ($3AgS.SbS_3$) did not give such good results, for if all the antimony be not entirely converted into antimonic acid, the blue colour of the starch compound is interfered with. The antimoniate of teroxide of antimony, sometimes called antimonious acid (SbO_4) is generally produced by the action of nitric acid upon antimony and its compounds, and doubtless this is the cause of the occasional fallacies I observed in the esti-

[1] *Comptes-Rendus*, Dec. 1856; *Chem. Gaz.* March 2, 1857.

mation of silver when in combination with this metal. On dissolving antimony in nitric acid, evaporating nearly to dryness, and freeing the residue from nitric acid, the white powder gradually but entirely decomposed a solution of iodide of starch. No difficulty whatever was experienced in compounds of silver and tin.

Mercury, as before stated, entirely vitiates the results, as a salt of this metal decomposes the starch compounds with great facility.

Note on the Numerical Relations between the Specific Gravities of the Diamond, Graphite, and Charcoal Forms of Carbon and its Atomic Weight, by Dr. LYON PLAYFAIR, *C.B. F.R.S.*

(*Concluded from page* 3.)

8. We know two other bodies besides carbon which possess diamond, graphite, and amorphous forms — viz. silicon and boron. If the same relation were observed between the specific gravities and atomic weights of these bodies, it would go far to establish as a law what, in an isolated case, might be due to a remarkable combination of chances. Unfortunately, we know only the specific gravity of the diamond forms of these elements:—

Silicon diamond	2·49	Deville.
Do. mean on six specimens	2·48	Playfair.

In quoting these results some explanation is necessary. In the original memoirs of Deville, it is left uncertain whether he examined the specific gravity of diamond or graphite silicon; and manuals of chemistry give it as the result due to the latter form; but from its coincidence with my own experiments on diamond silicon, it must unquestionably refer to that variety. Among the six specimens examined by myself, one preparation was in peculiarly fine crystals, and gave the sp. gr. 2·46; two out of the six specimens were prepared by Dr. Matthiessen, and gave a mean sp. gr. of 2·47. The remainder were inferior samples, and probably contained zinc and other impurities.

Professor Miller has kindly examined for me the specific gravity of a good specimen of graphite silicon in his possession (not analysed), and found it to be 2·337.

Deville gives as the specific gravity of boron diamond 2·68.

The crystalline form of the boron diamond is the same as that of the carbon diamond, and similar relations seem to exist between the specific gravity and atomic weights. The atomic weight of boron is 7·2, viewing its oxide as corresponding to carbonic acid in composition.

$$\sqrt[3]{7{\cdot}2} = 2{\cdot}683. \qquad \text{sp. gr.} = 2{\cdot}68$$

But the same relation would not appear to hold for silicon, which does not affect the like tendency to crystallise in the same forms as carbon and boron, although the relations between the numbers in its case also are in the same direction, and not devoid of simplicity.

The atomic weight of silicon is 14·2.

$\text{Si}\sqrt[3]{14{\cdot}2} = 2{\cdot}42$ sp. gr. of diamond silicon, = 2·46 to 2·48

$\text{Si}\sqrt[4]{28{\cdot}4} = 2{\cdot}30$ sp. gr. of graphite silicon, = 2·33

The differences exhibited in this case from the similar forms of carbon and boron are not sufficiently marked to throw doubt upon the relations as being due to some unexplained law. As an arithmetical probability, indeed, the discordance lessens the value of the testimony in the previous cases. But our chemical knowledge of the manner in which silicon doubles and quadruples itself in the silicates, to unite with the same quantity of base, gives support to the idea that its atomic weights may be different in the various forms of the separate element.

When we consider how much we multiply the errors of experiment in raising the observed specific gravities to the second, third, and fourth powers, it remains scarcely possible that the simple relations between them and the atomic weights, in the cases which I have pointed out, can be due to chance. I have purposely avoided any speculation as to the bearing which these relations may have on the molecular arrangement of the particles of the elements in their various forms, as I desire, in the first place, to submit the testimony on which the relations themselves are founded to the consideration of chemists.

But it may be fairly asked, whether any similar relations exist between the specific gravities and atomic weights of the remaining solid or liquid non-metallic elements. I take the following mean specific gravity for bromine, iodine, sulphur, and selenium, and omit the only two remaining elements—phosphorus and tellurium — from the list, because they do not appear to yield relations at all analogous to those under consideration:—

Bromine, sp. gr. . . .	2·966	Balard.
	2·980	Lowig.
	2·990	„
Mean	2·979	

Iodine.—There is only one recorded specific gravity of this element—viz. that by Gay-Lussac. I have estimated the specific gravity of two fine specimens in my laboratory, and take the mean of these results:—

	4·948	Gay-Lussac.
	5·030	Playfair.
Mean . .	4·980	
Sulphur, sp. gr. . .	= 2·0	
Selenium . . .	4·30	Berzelius.
	4·32	„
	5·31	„
Mean . .	4·31	

Tabulating these results, and bringing into comparison with them the roots of the atomic weights, we have the following striking accordances:—

	Sp. Gr.	Equivt.	Roots.
Boron . . .	2·68	$\sqrt[2]{7{\cdot}2}$	= 2·68
Silicon . . .	2·46	$\sqrt[3]{14{\cdot}2}$	= 2·42
Bromine . . .	2·98	$\sqrt[4]{80{\cdot}0}$	= 2·99
Iodine . . .	4·99	$\sqrt[3]{127{\cdot}0}$	= 5·02
Sulphur . . .	2·00	$\sqrt[4]{16{\cdot}0}$	= 2·00
Selenium . . .	4·31	$\sqrt[3]{80{\cdot}0}$	= 4·31

TECHNICAL CHEMISTRY.

Smelting Copper Ores.

The most abundant ores of copper are pyrites, or a mixture of sulphuret of iron, sulphuret of copper, and earthy matters. The principle of smelting copper depends on iron having a stronger attraction for sulphur and oxygen than copper has. When copper ores are first exposed to heat, a portion of sulphur is driven off, and the metals become partially oxidised. On fusing, the proto-sulphuret of iron acts as a flux for the earthy matters, which float on the surface of the denser portion of the fused mass, and are drawn off as slag with an iron rake. By a repetition of similar operations, the remainder of the

iron and sulphur is got rid of, and the copper is left comparatively pure. This mode of operating is liable to several objections; the whole of the sulphur is wasted, a great part of which passing into the atmosphere, occasions much nuisance and damage round the works. The mode of separating the slag by skimming is defective, as copper must either be drawn away with the slag, or slag left with the copper. There is no certainty by this process of obtaining copper in an actual state of purity. Various modifications of this plan have been proposed as improvements, but the best mode of obtaining copper in a state of purity is by what may be termed the wet process, which consists in converting the metallic sulphurets into sulphates, and precipitating the copper in solution by means of iron. This is not a new process, but some improved modes of operating are recommended. The raw sulphurets should be first mixed with a portion of oxidised metals, and the mixture placed in a bed, so arranged that warm air may be forced upwards throughout the entire mass, while water is occasionally thrown over it to carry off the sulphates in solution as they form. Granulated metallic iron may be prepared by treating hæmatite iron ore, or any artificial oxide of iron, with carbon, steam, and moderate heat. Tanks or vats should be prepared, having an arrangement at bottom for distributing liquids uniformly over the entire area. The vessels are to be filled with granulated iron, and the mixed solution of sulphate of iron and sulphate of copper run in from such an elevation that it may rise through the iron by ascending filtration, depositing copper, and passing off at top as an entire solution of sulphate of iron. This is to be continued until the whole of the iron is converted into copper, when it is to be removed and purified by fusion in a furnace designed expressly for the purpose.

Artificial Formation of Ammonia.

The vapours which escape from iron blast furnaces may be regarded simply as the atmosphere highly charged with carbon, or as a mixture of carbonic oxide, cyanogen, and nitrogen. When steam at a sufficiently high temperature, and air excluded, is mingled with these gases, the oxygen of the steam decomposes the cyanogen, and converts the carbonic oxide into carbonic acid, while the hydrogen and nitrogen combine to form ammonia; thus carbonate of ammonia will result; but as it may prove difficult to condense this effectually, if the vapour of ammonia were conveyed into a chamber charged with an insoluble lumpy material, so arranged that the ammonia in ascending would come in contact with the cold solution of salt trickling down, carbonate of soda and muriate of ammonia might be at once obtained. If, however, an ample supply of sulphate of iron could be procured, it would be more advisable to fix the ammonia by means of sulphuric acid expelled from sulphate of iron, because at the same time pure oxide of iron would be produced, which would prove valuable in the subsequent forging of iron.

Alkali refuse should be composed of sulphuret of calcium and coke dust. When this is acted upon by steam with sufficient heat, the oxygen of the steam converts the calcium into lime, while the sulphur and hydrogen pass off as sulphuretted hydrogen. When the latter is mingled with the vapours from a dense purely carbonaceous fire, consisting of carbonic oxide and nitrogen, the latter combines with the sulphuretted hydrogen, and forms sulphuret of ammonia. If these vapours are then partially cooled down and a large quantity of cold air admitted, the carbonic oxide becoming carbonic acid, combines with the ammonia, and disengages sulphur; thus carbonate of ammonia and sublimed sulphur might be obtained. If, on the other hand, the heat of the vapours is maintained, and a large quantity of heated air thrown in, the sulphuret of ammonia is converted into sulphite, which rapidly passes into sulphate of ammonia; by means of which more salt may be decomposed; and thus alkali refuse may be brought to yield sulphate of soda, muriate of ammonia, and carbonised lime dust. This latter material will be valuable in agriculture; it should be worked into the land when preparing it for seed; muriate of ammonia being afterwards applied to the growing crop, when the first shower of rain will carry it into the soil, when carbonate of ammonia will be disengaged in direct contact with the root of the plant.

By treating gypsum or sulphate of lime, with small coal and high heat in a reverberatory furnace, it would be reduced to sulphuret of calcium, and may, by a similar mode of treatment, yield the same products as alkali refuse.

PHARMACY, TOXICOLOGY, &c.

On the Explosion of Hypophosphite of Soda, by M. Trommsdorff.

Under the heading of "Caution,"[1] Dr. L. C. Marquart describes a violent explosion of the above salt, while its solution was being evaporated in a porcelain capsule, placed in a heated sand bath, for which reason too high a heat was assigned as the cause of explosion. It was therefore thought necessary to avoid evaporating such a solution, either over the fire or in a sand bath, but to employ altogether a water bath for its evaporation. This operation has been carried on very frequently in my laboratory without the occurrence of the least accident, but last spring I experienced, by a painful accident, that even the low temperature of boiling water is no safeguard against explosions of this salt.

The neutral solution of hypophosphite of soda was evaporated in small portions in a porcelain dish, heated by a simple water bath, the concentrated liquid being constantly stirred with a glass rod or a porcelain spatula. The last portion had become nearly dry, when a violent explosion took place, breaking all the windows of the laboratory, and seriously lacerating the face of the attending workman. Being near at hand, and supposing the explosion to have been caused by the neglect of the water bath, I hurried to the spot, but found the bath filled with boiling water, and was unable to discover the least suspicious circumstance from which the cause of the accident might have been explained.

The preparation which the author is using now is of French manufacture, and has a strong alkaline reaction. Should it, in this state, be less subject to explosions, it would be highly interesting to hear of the experience of the French and other chemists with regard to this new medicinal salt, which they are preparing in enormous quantities.

[1] *Archiv d. Pharm.* lxxxv. 384.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture I. *The Surface of the Atlantic.*

(*Concluded from page 15.*)

Besides the tidal wave the ocean is also affected by those great currents which are frequently mentioned and described, and which are known as drift currents. I have already mentioned the way in which the wind lifts up the waters on the western side of the Pacific Ocean, down along the coast of Africa by the Indian Ocean. The water lifted up there is pushed forward into the Atlantic. The course of the stream is tolerably manifest. The real effect produced is a distinct current of water, not a tidal wave, in other words not a mere motion *in* the water, but a motion *of* the water. A current crosses the Atlantic Ocean from the Coast of Africa to the Coast of America. It is not a considerable current, but it gradually works its way into the Carribbean Sea and the Gulf of Mexico. The waters in this sea are exceedingly hot, of course requiring the temperature of the Tropics. Emerging from these inland seas the water passes out between Florida and the Bahamas, as a distinct deep current of hot water of the temperature of 88° of Fahrenheit, with a depth of nearly 400 fathoms, moving at the rate of somewhere about 60 or 80 miles per day, and it is driven first northward towards the banks of Newfoundland, and then across until it reaches the middle part of the North Atlantic Sea. When it reaches here it disperses; the greater part of it seems to move round southwards, but sometimes portions seem to reach the coast of Norway, and frequently Scotland. The cause of this current is not clearly known. It has generally been supposed to be due to the wind, but it may also be caused by the current of cold water constantly setting from the pole to the equator, and there rising to the surface. It is a well known fact that the temperature of deep water is always very much lower than surface water in all the warmer parts of the ocean, and it is only when we get to the cold parts of the earth that the temperature is as cold at the surface as in the depth. The motion of the earth would tend to carry the water in the direction in which the Gulf Stream goes. The quantity of water setting northward from the equator towards the pole would have a tendency to be carried eastwards, and it would have this because the motion of the water is connected with the rotation of the earth. At the equator the rotation of any point at the surface is such that it passes over 70 miles for each degree of longitude; but if water having this rate impressed upon it is carried northwards till the degrees of longitude are narrower, it will pass over more such degrees in an hour than at the equator, inasmuch as the number of miles would be but little diminished. Thus in latitude 30° the degree is only 60 miles, and in latitude 45° only 50, while at 60° it amounts only to one half its original breadth, 35 miles. When therefore with the momentum acquired at the equator the water is carried by a current into higher latitudes, it appears to move towards the east. This explanation has been given by Lieutenant Maury, and it is one not without considerable value. At any rate there would be a tendency to set towards the east, instead of going directly north, and this is the state of the Gulf Stream. The effect of the Gulf Stream is seen on our shores in the most marked manner in the way of climate. When the stream reaches the latitude of New York, and runs to the north-east, you will observe that the whole tendency of the warm water is to cross the Atlantic to the western side, and not to touch the eastern side. Coming down as it does from the great openings from Baffin's Bay the ice and cold water pushes its way down by the western parts of the ocean, and running down the coast of North America almost to the tropics. In this way the climate is exceedingly cold on the west side of the Atlantic compared to the east side, and you may easily conceive that if anything should occur to send this Gulf Stream over the American land into Baffin's Bay, which is extremely possible, the result would be that instead of the western coasts of northern Europe being able to cultivate almost every possible vegetable production in consequence of a climate exceedingly genial and mild, we should have a climate worse than that of Newfoundland and Labrador, which would be a difference which would of course materially affect the condition of the human race in this part of the world. It is hardly possible to exaggerate the importance of a change of this sort. The position of that stream of water affects the climate of the whole of one large district to such an extent as to make it the most habitable portion of the earth. The Atlantic waters not only have their peculiar motion, but they have some other phenomena. They have in various parts peculiar tints of colour. The Atlantic water where it is deep is generally of a rich ultramarine blue, passing occasionally into emerald green and occasionally into deep indigo blue. The deep indigo blue is a remarkable characteristic of the warm waters of the Gulf Stream; the ultramarine blue is more characteristic of those waters out of the range of the Gulf Stream, and the emerald green is more common in the shoals. But besides these deep tints there is a considerable variation of colour at the approach of bad weather, and without any great amount of change perceptible in the atmosphere. Thus when the wind shifts the colour will change from blue to green, and sometimes to a slatey grey, and people accustomed to the Atlantic can even guess the time that will elapse between the change of colour of the water and the coming of the storm, although the change of sky colour cannot be determined by any of those instruments which enable us to measure the blue of the sky. Humboldt tried this, and found that the tint of the sky was not varied with that of the water, and believe that it was owing to some other cause than that which could be detected in the atmosphere. With regard to the actual ultimate cause of the colour of the water, I suppose there can be very little doubt that it is physical and connected with the water itself. No doubt water is an universal solvent, and this may be the cause of its having a colour. This colour is connected with the absorption of the other rays, so as to leave an excess of pure ultramarine blue. It is a peculiar optical effect. There is, however, one other cause,—animalcules and vegetation. It is a frequent occurrence to find the surface of the water cloudy, and in this case it is loaded with animal matter. I have myself seen in the waters of the Tagus the whole waters of the river, which are in most cases tolerably clear, completely whitened with jelly-fish, *medusæ*, and animals of that kind, which are sometimes present to such an extent as to occupy not only the surface of the water but to reach to a great depth. Medusæ are of various sizes; sometimes as large as one's hand and sometimes as large as 8 or 10 feet in circumference. They generally approximate to the form of an umbrella, but have a number of threads of various colours passing downwards. They are important not only with reference to the physical nature of the water, but also its capability of sustaining life, and its being the food of large animals, indirectly of whales, but directly of cuttle fish and others on which whales feed.

There are parts of the Atlantic Ocean, between the south limits of the Gulf Stream and the latitude of the Cape de Verd Islands, where is a sort of eddy on which an enormous quantity of floating seaweed is always seen. It is known by various names to sailors. The "tropic grape" it is called by some. The Sargasso sea is the name generally given to the district. The weed is *Fucus natans*. It is somewhat of a bulgy shape, of a pale olive-green colour, and is seen floating on the ocean sometimes in large and sometimes in small quantities. Although I have never known it, it is said that this weed is occasionally so thick that a ship can hardly sail through it. Whether this be so or not, it is certainly of such abundance as to make a considerable appearance and to be troublesome. Besides those phenomena which I have described, I should also say a few words as to the presence of ice. This

occurs chiefly in the Arctic and Antarctic Seas, which touch the Atlantic on the north and south. The Arctic Sea sends down large masses of ice which reach the Gulf Stream; some comes from Baffin's and Hudson's Bay, and there seems to be a constant travelling upwards and downwards northwards during certain parts of the year, and southwards during other parts of the year. Occasionally it comes so far south as to cross the Gulf Stream before it gets thoroughly melted.

Such, then, are the characteristic phenomena of the broad Atlantic, so far as I have been able to present them within the limits of time allotted on the present occasion, and so far as they can be described without considering more than relates to the surface. But there yet remains one other light in which we should regard this ocean, and it is one which has especial reference to man.

All the early civilisation of the human race was on or near the shores of the Mediterranean, except, indeed, that of India, of which we know nothing; and China, the nature of whose intelligence and inventive genius we merely guess at, and which certainly was only progressive to a very limited extent.

For long centuries the Pillars of Hercules formed a limit to the exploration of even the most enterprising of maritime nations of the coasts of Europe and Africa, or, if passed, it was with fear and trembling. But time and the discovery of more convenient means of navigation and greater resources accustomed men by degrees to the dangers of open water, so that the shores of the Atlantic became at first familiar, and were soon left far out of sight. The Atlantic Ocean was thus regarded more and more clearly as one of the great highways of mankind; it ceased to be pathless and became the path; it bore upon its bosom the navigator fearlessly making discovery of new lands, the merchant with his venture seeking new foreign markets for his wares, and new products for the home market of his own people; the speculative emigrant, dissatisfied with the land of his fathers, and looking for a new home for his children; the war ship, carrying destruction to the enemy and making a battle-field of the waves. Then were opened out to the geographer all the details of form and proportion of the land, the distant continents and islands, whether previously visited or until then uninhabited, and by slow degrees there was obtained that accurately mapped representation of the boundary of land and water on which very much of the material advance of the human race has since depended.

It is, then, rather as the link which unites the distant shores than as the gulf which separates them that we should regard this great Atlantic. A short voyage of a few days, performed not merely with ease but luxury, and a near approach to certainty in point of time, is now sufficient to carry not only ourselves but the heaviest and bulkiest goods from one shore to the other. All along its extended line of coast, its numerous indentations form available harbours of shelter and convenient localities for maritime ports. Those fifty important rivers, many of them navigable for hundreds of miles, and all to some considerable distance in the interior of their respective continents and islands open into this canal, emptying into it the waters of more than half the land of the globe, and on this coast and these rivers are to be found the largest, the richest, the most enterprising and the most cultivated families of the human race. These all communicate with each other by water, quite as readily and often much more readily than they can by land. Taking advantage of the great currents, whether of air or sea, and availing ourselves of the power of steam, the dangers and delays of ocean navigation are wonderfully reduced, and so well are the nearest and best paths now known that there is often a divergence of only a few miles in the tracks of ships crossing from one port to another in the same season, or in the successive courses of the same ship as she makes the frequent voyages and records them on her charts.

But this ocean, so useful, so well understood, so well adapted to the wants of man, is not without its terrors and its dangers. It is subject to fearful storms, to fogs yet more fatal, and to drifts of ice in large quantities, sometimes more to be dreaded than either of the other dangers. Steam has indeed overcome much of the delay once caused by a long continuance of unfavourable winds; a careful study of the barometer foretells those terrible convulsions of the air which even when foreknown cannot always be escaped, and the thermometer often serves to indicate the vicinity of large fields of floating ice. Thus it is that in a majority of cases science is at hand to enable the skilful navigator to make such provision against a coming and known danger that the evil consequences are avoided. Thus the paths of this ocean are more easily and more safely travelled; the gulf has been narrowed, so far as human interests are concerned, just as distances on land have been diminished by the railroad and the locomotive; and it is now a matter of less uncertainty and even of much shorter time to reach America than half a century ago it was to cross to the nearest point of France. Men run to and fro upon the earth, and knowledge is increased; distant countries and the distant peoples inhabiting them are united in bonds of mutual interest and good-feeling, and the Atlantic Ocean, once an object of terror from its supposed immensity, its winds and its waves, its ice and its drifting currents, its dangerous shores and its treacherous deeps, may now be regarded as a convenient channel, bearing on its bosom the riches of the world, conveying cheaply and with comfort the wanderer to his new home, and the natural productions or manufactures of one country to another; eminently favourable to civilisation and progress, and enabling the improvement and advantages of one half of the world to be rapidly communicated to the other half.

SOCIETY OF ARTS, *Wednesday, 23 May* 1860.

Dr. W. A. Miller *in the Chair.*

Mr. W. P. Jervis read a paper at this meeting on *The Marbles of Tuscany and the Boracic Acid Lagoons of the Maremma.* After introducing his subject in general terms, he said:—

"Serravezza, a little town with a population of about 2000, lies six miles from the coast of the Mediterranean, and 36 north of Leghorn, at the foot of the spurs of the Monti Altissimo and Matanna, where two rivulets, the Serra and Vezza, join to form the Vesiglia or Serravezza river. Starting from this town, and proceeding eastward up the Vezza for four miles, we reach Ruosina, passing on the road a multitude of quarries of slate-coloured or *Bardiglio* marble, chiefly situated on the lower slopes of the hills. Some is perfectly plain, *bardiglio unito*; when dark, it is known as *bardiglio scuro*: other quarries, near Farnocchia, higher up towards the Monte Matanna, on the Canale delle Mulina, produce a light blue variety, with black veins, called *bardiglio fiorito*. A similar marble occurs near Carrara, but as the Tuscan bed yields a stone of greater hardness they are preferred, and have been worked for the last sixteen centuries at least. Signor Santini, of the School of Fine Arts, informed me that the "Lion" and the "River" of the Vatican, and the "Slaves" of the Campidoglio at Rome, which date from the time of Antoninus, are sculptured in Serravezzan bardiglio. The same marble has been employed in many buildings in Florence. It is of Triassic origin, and the oldest in Tuscany.

"Above this comes a celebrated ornamental stone, termed *Mischio di Serravezza*, formed from the fragments of rock which have been chipped off the parent mass, or separated by violence or pressure; they have become subsequently united by a hard cement of amphibole, or specular iron, filling up all the interstices, as if semifluid matter were poured over a heap of broken stones by the roadside; the result being a hard, compact breccia, perfectly free from fissures. The paste, when highly ferruginous, tinges the fragments of white marble of a pale pink; the presence of a large quantity of silicates often renders the breccia very much harder than ordinary marbles.

"The analysis of the cement made at Pisa by Passerini, gave—

Silica	39·0
Peroxide of Iron	22·0
Alumina	30·5
Magnesia	3·0
Lime	2·0
Water and Loss	3·5
	100·0

Our limited space compels us to omit much relating to the Tuscan marbles, to make room for matter which we believe of more interest to chemical readers.

The general characters of boracic acid lagoons, and "*soffioni*," are probably known to our readers, so we will not transcribe the lengthy account given by Mr. Jervis—an incidental quotation may suffice. A Tuscan traveller who visited the Volterra salt works in 1742, proceeded to examine the lagoon phenomena, and learnt among other things that:—

"A farmhouse, near Castelnuovo, built 200 years before, had been suddenly undermined, a *fumacchio*, or incipient lagone, having unceremoniously made its appearance in the kitchen, and rapidly assumed the dimensions of a true lagoon. The inhabitants were utterly defenceless, and bade adieu to their ancestral tenement, the stone walls of which were soon attacked by the corroding influence of the vapours, and speedily destined, as our traveller truly predicted, to crumble to pieces. Within certain limits fertile fields were subject to be laid waste, and poisonous gases escaped, which had frequently proved fatal; thus he relates how a swineherd in charge of forty pigs had been overtaken by the noxious gases; all the poor animals were killed but one; the witty peasant would have shared the same fate but for his presence of mind, for, according to the version he made of his exploit, while unable to walk away, he rolled himself over and over on his side till he arrived at the bottom of the hill, where the air was pure. A less fortunate man, who was working in an alabaster pit, was suddenly overpowered by the escape of mephitic gas through the marls, and cried loudly for help from his fellow at the mouth of the shaft; while he was being hauled up he was stifled by oppression of the lungs, and fell lifeless to the bottom. Should any luckless wight approach a lagoon too closely he stood the chance of sinking into a quagmire and losing a leg. Sheep occasionally fell victims when rushing too carelessly along, and after remaining a short time in the water nothing but the bleached skeleton remained."

Boracic acid was first found in the *lagoni* by Hæffer chemist to the Grand Duke, in 1777, and his researches, were confirmed by Prof. Mascagni, two years later. Fossi obtained the acid in larger quantities, and exhibited in Florence in 1818 some white glass made with borax from the lagoons. Sig. Ciaschi was employed as engineer at the lagoons of Monte Rotondo by Messrs. Guerazzi and Brouzet in 1815, but he died in the following year from having fallen into a fissure.

In 1818 M. Lardarel, a French gentleman, attempted the formation of some boracic acid works, but at first with but partial success, for up to 1827 the expense of firewood for evaporating was nearly equal to the commercial proceeds; at length, however, he thought of utilising the natural steam-jets or *soffioni*, and applying them to the purpose indicated above. Success rewarded the patience and ingenuity of M. now Count Lardarel at last, and no fewer than nine separate establishments now belong to him. The details of the arrangements for evaporation and crystallisation we are forced to omit for want of space, but they are of a simple although ingenious nature.

Whether boracic acid nominally exists as such, seems extremely doubtful; on this point the following remarks may not be uninteresting:—

"Singularly enough, boracic acid has never been found in the solid state at any depth to which search has been made; it is probably either the result of the double decomposition of water and a volatile salt of boron, according to Dumas' theory; sulphide of boron and water producing boracic acid and sulphuretted hydrogen, thus:—

$$BoS_2 + 4HO = BoO_2 + 2HO + HS.$$

in support of which supposition, we only find the boracic acid appear when there is water present; or it may be caused by the reaction of sulphuric acid on borates, such as tourmaline, the granite found not very far off being so rich in this mineral as to bear the name tourmaliniferous granite. It is a point which I should wish to place before abler chemists for their approval. The theory I advance is tenable, provided we assume the heat to be very great. Though sulphuric acid is one of the most powerful, and boracic acid the weakest, next to carbonic acid, at ordinary temperatures, they exhibit the reverse phenomena at very elevated temperatures; in fact, boracic acid under such circumstances will actually decompose sulphates formed by the action of sulphuric acid on borates. Before water is introduced into the fissures they are mere *soffioni*; borates of several bases are most probably abundant at great depth, and are uninjured by the constant passage of sulphurous vapours, and even sulphuric acid, on their way to the surface, whence the latter escape, but boracic acid is not to be detected. Water being now introduced lowers the temperature, and the balance of affinities is altered, the powerfully corroding influence of the sulphuric acid on the borates is set in orperation, whence the boracic acid is liberated, and ascends in solution with the ejected water and steam. Sulphates of ammonia and lime, gypsum, alum, &c. are among the minerals abundant around the lagoons."

As regards the composition of the crystals, and the application of boracic acid to glass and porcelain, Mr. Jervis said:—

"The boracic acid crystals are far from pure, containing a small quantity of numerous sulphates mechanically mixed. In 1842, Wittstein, *Rapp. ann. de Berzelius*, published the following analysis:—

Boracic acid, crystallised ($3HOBO_3$)	76·494
Sulphate of Iron	00·365
„ Alumina	00·320
„ Lime	1·018
„ Magnesia	2·632
„ Ammonia	8·508
„ Soda	0·917
„ Potash	0·369
Chloride of Ammonium	0·298
Water of crystallisation of the above salts	6·557
Silicic acid	1·200
Sulphuric acid combined with boracic acid	1·322
Traces of organic matter and sulphate of iron	—
	100·000

"The amount of foreign salts has very considerably diminished since the lagoni were first made use of; I believe it is not more than 13 per cent. at this time. In order to purify the crude produce, which is not done in Tuscany, nothing is necessary but to re-crystallise it once or twice.

"It will suffice to mention that the uses of boracic acid are only limited by the supply. The greater part of what Count Lardarel produces is exported to England, that of M. Durval supplying the necessities of the French market. Mr. Wood, in 1820, applied boracic acid to glazing pottery, and for that branch of industry an enormous quantity is consumed. With silicates of the alkalies and various metallic oxides, it forms that beautiful and brilliant flesh-coloured glass, made at Sèvres, of which the composition is as follows:—

Silica	19·23
Protoxide of lead	57·64
Soda	3·08
Boracic acid	7·00
Peroxide of iron	6·12
Oxide of zinc	2·99
Antimonic acid	3·41
Potash	0·44
	100·000

(Salvetat, *An. de Ch. et Ph*, 3rd sér. tom. xv. p. 122.)

"The glaze for common English porcelain differs only from that employed for figures and ornaments in the amount of borax and silica. Their respective composition is:—

Felspar	45	45
Silica	9	12
Borax	21	15
Flint glass	20	20
Nickel	4	4
Minium	12	12

(Dumas, *Tr. de Ch.* tom. ii. p. 265.)

"I was informed by several persons that the vines in the neighbourhood of the lagoons do not get the Oidium disease, which is doubtless attributable to the sulphurous vapours which arise so plentifully and pervade the atmosphere—perhaps even to the sulphuretted hydrogen in a less degree; hence this locality is well adapted for the growth of vines, wherever the soil in the lower valleys admits of their cultivation. May not this continual vapour of sulphurous acid be the chief reason of the excellence of the celebrated *Lacrimæ Christi* vines of Vesuvius, to grow which the Neapolitans incur the risk of having their vineyards overwhelmed every time there is a lava flow. For a similar reason, I would rather ascribe the superiority of the Canary wines to the sulphurous bath to which they are subjected than to the richness of the soil, though that is also incontestable."

The concluding portion of the paper was devoted to a kind of memoir of the more recent labours of Count Lardarel, and the discussion which followed was also somewhat out of our province, turning chiefly upon marbles, less in a scientific than a practical point of view. The paper was illustrated by numerous specimens and diagrams.

A vote of thanks was passed to Mr. Jervis.

THE BRITISH ASSOCIATION.

The Annual Meeting of the British Association for the Advancement of Science will be held this year at Oxford, commencing on Wednesday next, June 27th. The Chemical Section will of course be presided over by Professor Brodie, the Secretaries being Messrs. Harcourt and Northcote. We hope to be enabled to lay before our readers full abstracts of the various papers read before the Chemical Section, as well as of everything else which may appear to us likely to interest or instruct our readers.

CORRESPONDENCE.

Impurities in Common Washing Soda.

To the Editor of the Chemical News.

Sir,—As the common washing soda sold at the oil and colour shops is frequently used for common purposes as carbonate of soda in the laboratory, I would direct your readers to the importance of examining this substance before using it as carbonate of soda, as I find that it is frequently mixed with large quantities, and indeed at times almost entirely consists, of sulphate of soda or Glauber's salt. I subjoin the percentages of Glauber's salt contained in samples of washing soda obtained from different shops.

Percentages of Glauber's Salt in Washing Soda.

No. 1. contained	1·5	per cent.
2. "	1·7	"
3. "	1·9	"
4. "	32·9	"
5. "	93·7	"
6. "	95·5	"

The first three of these are as pure as could be expected, but the two last consist almost entirely of the sulphate.

I am, &c. Henry Matthews, F.C.S.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

The most delicate Tests for Peroxide of Hydrogen. — M. Schönbein gives the following as the most delicate tests for peroxide of hydrogen.

1. *Iodide of Potassium, Starch, and Ferrous Sulphate.*—Starch with iodide of potassium is blued very slowly when the peroxide of hydrogen is diluted with much water; but when the liquid contains only $\frac{1}{50000}$th, an intense blue colour is immediately produced; if, after the iodide of potassium and starch solution a few drops of a solution of ferrous sulphate are added.

2. *Ferricyanide of Potassium and a Ferric Salt.* — Water containing the peroxide immediately blues a very dilute mixture of the above reagents, for it reduces the ferric to a ferrous salt, which gives Prussian blue with the red prussiate.

3. *Permanganate of Potash.*—This salt is reduced by the oxygenated water, oxygen being disengaged. If then to water containing $\frac{1}{50000}$th of the peroxide of hydrogen, and slightly acidulated, we add enough of the permanganate to give a rose colour to the mixture, the colour disappears after a little time.

4. *Indigo and Ferrous Sulphate.* — Water containing $\frac{1}{50000}$ of peroxide of hydrogen coloured a light blue with indigo is rapidly decolorised when a few drops of a dilute solution of ferrous sulphate are added.

5. *Chromic Acid.*—A solution of this acid is turned blue by peroxide of hydrogen, but the colour quickly disappears. When using this test a little ether should first be added, and then the chromic acid, and the whole shaken well together: the ether, on separating, is found to be coloured blue.

Electrolysis of Compounds of the higher Orders.—The possibility of the direct electrolysis of binary compounds containing more than one equivalent of their elements has been disputed by some, and admitted by others on insufficient grounds. Buff[1] has made experiments to rectify some of the errors current on this subject.

Iodic Acid.—Magnus has stated that iodic acid dissolved in water is decomposed by the electric current, but according to Buff the true electrolyte in the experiment is not anhydrous iodic acid, but the hydrated acid IO_6H, and the precipitation of the iodine at the negative pole is owing to the secondary action of the hydrogen disengaged. If the electrolysis takes place in a U tube which has iodic acid in the bend and positive arm, and distilled water in the negative arm, hydrogen is disengaged at the negative electrode, but there is no deposition of iodine where the distilled water and the iodic acid solution touch.

Protochloride of Copper. — Cu_2Cl. The salt is readily decomposed in an ammoniacal or hydrochloric solution, or by placing the fused salt between the electrodes of copper. The most exact way to measure the amount of decomposition in the last case is to weigh the positive electrode before and after the experiment; the loss of weight is clearly equal to the amount of copper deposited on the negative electrode, which it is difficult to separate from the mass of the salt.

Sesquibasic Nitrate of Suboxide of Mercury. — $3Hg_2O\ 2NO_5\ 3HO$. This is the most easily decomposed of the salts of the suboxide of mercury. In a concentrated solution, 2 equivalents of mercury are precipitated for each equivalent of copper reduced in a sulphate of copper voltameter.

Chloride of Aluminium liquefied by heat is easily decomposed into chlorine and aluminium.

Protochloride of Antimony is decomposed either in a state of fusion or solution in hydrochloric acid.

Bichloride of Tin is a perfect insulator, and undecomposable in the anhydrous state.

Perchloride and Oxychloride of Phosphorus.—Bad conductors, and undecomposable even at their boiling temperatures.

[1] *Annal. der Chem. und Pharm.* Bd. cx. s. 257.

Chloride of Arsenic. — $AsCl_3$. Apparently a weak conductor, but the result of the experiment was doubtful.

Molybdic Acid.—Easily decomposed in a state of fusion. The experiment is stopped after a time by the formation of a solid crystalline mass, which appears to be a molybdate of the oxide of molybdenum, $MoO_2 2MoO_3$. It seems probable that the immediate results of the electrolysis are oxygen and oxide of molybdenum, and that the last body combines with the undecomposed molybdic acid.

Vanadic Acid.—Decomposable in a state of fusion, giving oxygen and oxide of vanadium.

Chromic acid in solution behaves exactly like sulphuric acid. Hydrogen is disengaged at the negative pole, and at the positive the elements of the grouping CrO_4; but the secondary action of the hydrogen occasions the formation of a variable quantity of the chromate of oxide of chromium.

Bichromate of Potash in a state of fusion appears to behave like a mixture of chromic acid and neutral chromate of potash. The last salt is decomposed like a sulphate, and the chromic acid is decomposed into oxygen and sesquioxide of chromium.

In conclusion, Buff states that most of the natural metallic oxides and sulphides which are conductors at the ordinary temperature, become better conductors when heated. It is probable therefore that in a state of fusion they would be electrolytes.

III. TECHNICAL CHEMISTRY.

Combustibility of Tobacco.—M. Schlœsing[2] gives the results of his experiments on the growth of tobacco under the influence of different manures. We have already given some of the results of M. Schlœsing's former investigations (see Chemical News, Vol. I. p. 239) in which he shows that the combustibility of tobacco depends on the amount of potash salts it contains; accordingly he finds that when tobacco plants are watered with a solution of a potash salt the leaves are very combustible, but when watered with a solution of a lime or magnesian salt the leaves are almost incombustible. In all cases, however, he obtained an extraordinary amount of nicotine, for which he cannot account.

New Way to discover Leaks in Gas-pipes.—The usual way of looking for them with a lighted candle our readers know sometimes results in an explosion, a fire, and one or two deaths. Now M. Fournier suggests another way, which is very simple, and perfectly safe. He charges the pipes with ammoniacal gas, and then goes along them with an open bottle of hydrochloric acid. Our readers know the rest. M. Fournier claims one of the Monthyon prizes for his invention.[3]

Cast Platinum.—At the last sitting of the Academy of Sciences, MM. Deville and Debray exhibited two ingots of platinum weighing together a little over 55 lbs. av., which had been melted in the same furnace, and run into an ingot mould of forged iron. The furnace used was that described in the Chemical News, Vol. I. page 6. The authors announce that platinum may be melted in any quantity, and once melted it behaves precisely like gold or silver, requiring exactly the same precautions as in casting the precious metals. They also exhibited a platinum cog-wheel, cast in an ordinary sand mould, in the same way as other metals, thus giving a new proof of the possibility of giving platinum all the forms that may be desired by their process.

On the Purification of Sulphuric Acid from Arsenic.[4]—The statement which appeared in the journals last year, that sulphuric acid may be entirely purified by heating it with chloride of sodium, recommends a process, apparently very easy, but which cannot be carried out in practice.

Sulphuric acid, when brought in contact with common salt or sal-ammoniac, evolves much muriatic acid gas; 1 drachm of chloride of ammonium was therefore introduced into a small retort, together with 15 grs. arsenious acid and ½ oz. water, to which 3 oz. sulphuric acid were gradually added; muriatic acid gas was evolved, but not in very large quantity. Heat was now applied, and each half-ounce of the distillate was tested for arsenic in Marsh's apparatus. The following was the result:

1st. The first half-ounce contained so much arsenic, that a metallic mirror was separated on the introduction of a zinc rod into the distillate.

2nd. The second half-ounce contained both chlorine and arsenic.

3rd. The third and fourth half-ounces contained both in small proportions.

4th. The fifth half-ounce was free of chloride, and contained a minute quantity of arsenic.

5th. The residue of sulphuric acid, about one-third of the original weight, held much arsenic in solution.

This behaviour may be explained in this way, that an excess of sulphuric acid prevents the formation of chloride of arsenic; it may even be easily proven, that the latter compound, when treated with concentrated sulphuric acid, is decomposed into muriatic and arsenious acids, the latter of which remains behind on distillation.

It is worth mentioning that English oil of vitriol (not the rectified) obtained from a manufacturer of Moscow, was free of arsenic, nitrous acid and lead, and left a residue consisting of the sulphate of potassa and of earthy matter.

In the *Archiv* for September, 1858, Neese proposes the distillation of sulphuric acid from a retort bedded in ashes. Frederking recommends this precaution, inasmuch as he has rectified the acid in the manner indicated for the last twelve years.

[2] *Comptes-Rendus*, p. 1027.
[3] *Cosmos, Liv.* xix. 1860, p. 524.
[4] *Archiv. d. Pharm.*

MISCELLANEOUS.

An American Coal.—A discovery of coal has been made in the neighbourhood of Cairo, on the North-Western Virginian Railroad (U.S.), which is of a very peculiar character. A specimen of the coal has been tested by various chemists, and has been found to be, as it were, crystallised mineral oil, being without stratification, and free from any foreign substance. The tests have shown that it will yield 165 gallons of crude oil to the ton. After one refining process, 82 per cent. of refined oil was obtained; after a second distillation, 61 per cent. of the whole amount was obtained in pure oil, and 30 per cent. of lubricating oil and paraffin. By taking a portion of the coal and laying it on a hot stove or shovel, its extraordinary quality is obvious. It melts and runs like wax. It is considered probable that, if shafts are sunk deep enough, a reservoir of mineral oil similar to that in Venango county will be reached, from which this vertical vein of solid oil has originated.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

An Old Subscriber.—The formula for the Pulv-Bismuthi Co. of the Skin Disease Hospital Pharmacopœia is as follows:—Bismuth Trisnitrat. ℥ss; Plumbi Chromatis, ℈j; Carminii, gr. x.; Hydragyri Bisulphureti, gr. x. Misce.

A Practical Chemist.—Your supposition is correct. The resin contains two or three acids which combine with the potash, and the carbonic acid is evolved.

F.—1. The process might answer, but it does not look likely. It is not the one in use, we believe. 2. A battery is not made use of.

J. J. J.—Will find the information in *Cooley's Dictionary of Practical Receipts*, and *Piesse's Perfumery*.

Lumière.—Received with thanks.

F. H. T.—Consult a work on the metallurgy of iron.

Vol. I. of the Chemical News, containing a copious index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Organo-Metallic Bodies. The Substance of a Discourse delivered to the Chemical Society, June 7, 1860, by Dr. E. FRANKLAND, *F.R.S.*

ORGANO-METALLIC bodies, as a distinct class of compounds, are, with one exception, the creation of the last ten years; their derivatives, however, have been known for a much longer period. From the time that an organic acid was first united with a metallic base, organic compounds containing metals date their existence, and although it is not usual to regard them in this light, a little consideration will show that such salts bear the same relation to organo-metallic bodies that ethers, alcohols, acids, &c. do to the alcohol radicals. Thus zinc-ethyl yields by oxidation ethylate of zinc (ZnO,C_4H_5O), a body analogous to the well known ethylates of potash and soda; and ethylate of zinc by farther oxidation yields acetate of zinc. In the same way the acetates of potash and soda may be considered to be derived from potassium and sodium ethyl. The propionates of the alkalies have already been actually derived from potassium and sodium ethyl respectively, their formation depending upon the action of carbonic acid upon these organo-metallic bodies.

Having pointed out the difference between organic compounds containing metals, and organo-metallic bodies, restrictedly so called, the lecturer confined his farther remarks to the latter class of substances.

Modes of Formation.—The general methods are four in number:—

1st. By union of the organic radical in the nascent state with the metal. In this way the zinc, cadmium, magnesium, aluminium, and glucinum, -methyls, -ethyls, &c. are formed. Thus:—

$$Zn_4 + 2\left.\begin{matrix}C_4H_5\\ I\end{matrix}\right\} = Zn_2\left\{\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right. + 2\left.\begin{matrix}Zn\\ I\end{matrix}\right\}$$

Some intermediate stages occur in the production of some of these bodies, but the final result is correctly expressed in the above equation. An elevated temperature is usually necessary for the reaction.

The same general method is most convenient for the production of the compounds of tin with alcohol radicals. Their iodides are also thus formed. Tin forms three classes of binary compounds, as seen in the annexed formulæ, in which R represents a radical:—

$$SnR \qquad Sn_2R_3 \qquad SnR_2$$

This threefold atomic character of tin necessarily complicates the results of its action upon the iodides of the alcohol radicals, but, at all events, the following series, containing positive organic radicals and negative inorganic radicals, have been well established:—

$$\begin{matrix}(1.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\end{matrix}\right.\end{matrix} \qquad \begin{matrix}(2.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\\ R+\\ R+\end{matrix}\right.\end{matrix} \qquad \begin{matrix}(3.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\\ R-\\ R-\end{matrix}\right.\end{matrix}$$

$$\begin{matrix}(4.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\\ R+\end{matrix}\right.\end{matrix} \qquad \begin{matrix}(5.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\\ R-\end{matrix}\right.\end{matrix} \qquad \begin{matrix}(6.)\\ Sn_2\left\{\begin{matrix}R+\\ R+\\ R+\\ R-\end{matrix}\right.\end{matrix}$$

In stanethyl we have an example of the first series. Most of the tin organo-metallic bodies produced by this mode of formation belong however to the third series, and are all most conveniently formed by the action of light, rather than of heat, upon the mixture of tin and iodide of the alcohol radical. An illustration of this series is found in the stannic diethiodide $Sn_2\left\{\begin{matrix}C_4H_5\\ C_4H_5\\ I\\ I\end{matrix}\right.$

A type of the fifth series is seen in the dimethiodide of tin, $Sn_2\left\{\begin{matrix}C_2H_3\\ C_2H_3\\ I\end{matrix}\right.$, and of the sixth in stannic trimethiodide, produced by the reaction of four equivalents of metal and three of iodide of methyl, two equivalents of iodide of tin being also formed.

Some mercury compounds were also described as being obtained by this first general mode of formation.

2nd. By the action of alloys of the respective metals with potassium or sodium upon the iodides of the alcohol radicals.

The principles here involved are essentially the same as in the first mode, than which it is less applicable generally, but is peculiarly useful in the production of organo bodies of the polyatomic metals. Many bodies containing arsenic, lead, bismuth, tellurium, and tin, were described as being produced by this method, but the following example sufficiently illustrates the whole:—

$$Na_3Sb + 3\left.\begin{matrix}C_4H_5\\ I\end{matrix}\right\} = Sb\underbrace{\left\{\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right.}_{\text{triethylstibine}} + 3\ NaI$$

3rd. By the action of organo-zinc bodies upon either the haloid-compounds or the organo-compounds of the metals.

This method is most convenient for the production of organo-metallic substances containing less positive metals than zinc. By its means, compounds of mercury, tin, lead, antimony, and arsenic, have been obtained. The formation of stannic ethide typifies this method:—

$$2\ Zn_2\left\{\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right. + Sn_2\left\{\begin{matrix}Cl\\ Cl\\ Cl\\ Cl\end{matrix}\right. = Sn_2\left\{\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right. + 4\ ZnCl$$

4th. The displacement of the metal contained in an organic-metallic body by the introduction of a more positive metal.

We are indebted to Wanklyn for this method of formation, potassium-ethyl and sodium-ethyl having thus been obtained by him.

Properties of Organo-Metallic Bodies.—The organo-metallic compounds, as a class, are distinguished for the extraordinary energy of their affinities, an energy

that increases or diminishes in power according to the more or less positive character of the metal contained in them, as well as to the greater or smaller atomic weight of their radical. This energy appears however to be modified by the degree of saturation of the metal. Thus stannous compounds, in which the tin is only partially saturated, rapidly absorb oxygen when exposed to the air, while stannic bodies in which the tin is combined with as much radical as it can take up, are not in the least degree so acted upon. The semi-saturated organo-metallic bodies, therefore, play, of course, the part of radicals, until the metals contained in them are fully saturated, and then they at once cease to combine with other substances; farther action of powerful agents causing decomposition or re-arrangement.

The Lecturer then proceeded to describe the special properties of each class of organo-metallic bodies that have been discovered up to the present time, commencing with the most positive. The substitutive value of the compounds containing alkali-metals was referred to in cases where organo-zinc bodies failed to introduce positive radicals in the place of negative elements. The almost explosive violence accompanying the spontaneous inflammation of the same bodies, was illustrated on breaking a bulb containing a little sodium-ethyl. The absence of compounds of organo-zinc and magnesium bodies was adduced in support of the theory of atomic saturation, and the ethyl members of the aluminium and glucinum series were cursorily noticed.

Organo-zinc compounds are decomposed by water, oxide of the metal and hydride of the radical being produced. Oxygen converts them into the respective zinc alcohols, thus:—

$$Zn_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right. + O_4 = 2\left.\begin{matrix}C_4H_5\\Zn\end{matrix}\right\}O_2$$

Binoxide of nitrogen acts upon them in a manner resembling that of carbonic acid upon the organo-potassium and sodium bodies, as already referred to. Zinc-ethyl yields in this way dinitroethylate of zinc, $\left.\begin{matrix}N_2C_4H_4O_2\\Zn\end{matrix}\right\}O_2$, a salt strictly analogous to propionate of zinc, but containing nitrogen in the place of carbon. Sulphurous acid reacts similarly. The various ammonias form with them the corresponding amides, and double compounds with certain neutral salts have also been obtained.

The many tin compounds belonging to the several series before mentioned were then described. Stannous and sesqui compounds are oily liquids. The anhydrous stannic bodies are also liquids, but their hydrates and salts—for they are powerfully basic—are solid, and many of them beautifully crystalline.

Organo-bismuth bodies have been but little studied. They are spontaneously inflammable, and very unstable.

Organo-lead bodies. The ethyl group only of this series has been explored.

At present the representatives of the *organo-mercury* series all belong to the mercuric type. The instability of inorganic mercurous compounds, as seen in the oxide and iodide, seems brought to a climax in the organic compounds of this metal, any attempt to form them resulting in the production of metallic mercury and a mercuric body. Mercuric methyl, $Hg\left\{\begin{matrix}C_2H_3\\C_2H_3,\end{matrix}\right.$ is a colourless ethereal substance; it is remarkable as possessing the highest specific gravity of any known non-metallic liquid, viz. 3·069. Glass floats upon its surface.

Arsenic and Antimony Series. These important organo-metallic bodies are distinguished for the variety of their compounds. The remarkable polyatomic character of their metals not only renders their number very large, but the variation in the proportions of positive and negative molecules contained in them gives such a range to their chemical character as to produce, on the one hand, highly caustic bases, and, on the other, powerful bibasic acids. The arsenic series is perhaps the most interesting, because it contains cacodyl, the first discovered of the organo-metallic bodies. Bunsen's classical investigation of this substance has not only imparted completeness to our knowledge of the whole group, but has afforded a clue to the successful interpretation of many phenomena met with in other analogous series.

Methylic cacodyl $As\left\{\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right.$ boils at 170° C. and ethylic cacodyl, $As\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$ between 185° and 190°. It certainly is somewhat remarkable that as yet we have no decisive evidence of the existence of any corresponding body in the antimony series. By the action of bichloride of platinum upon chloride of cacodyl, at an elevated temperature, two equivalents of hydrogen in the cacodyl become replaced by a biatomic molecule of platinum, and the chloride of an interesting body produced, to which the name of cacoplatyl has been given. Its formula is thus represented, $As\left\{\begin{matrix}C_2H_3\\C_2Pt''H.\end{matrix}\right.$

The names and formulæ of a very large number of bodies belonging to the antimony and arsenic series, were exhibited on diagrams suspended from the walls of the Society's meeting room. Their relations to each other and to the inorganic compounds of the metals were thus made interestingly evident, but want of space forbids us printing the diagrams here. *Organo-tellurium* bodies were also shortly noticed.

Constitution and Theoretical Importance of Organo-Metallic Bodies.—In the year 1852, when but little was known of organo-metallic bodies, the speaker suggested a view of their constitution, and researches made since that time have greatly, if not completely, tended to confirm his theory.

According to this view, organo-metallic bodies are constructed upon the types of the inorganic chlorides, oxides, sulphides, &c. of the metals contained in them, the chlorine, oxygen, sulphur, &c. being replaced in equivalent proportions, and, step after step, by the alcohol radicals.

Thus organo-potassium, -sodium, -magnesium, -zinc, and cadmium compounds, are all formed upon the models of the chlorides of these metals, thus:—

Type $M_2\left\{\begin{matrix}Cl\\Cl\end{matrix}\right.$

(Examples.)

Potassium-ethyl $K_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$ Zinc-methyl, $Zn_2\left\{\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right.$

Magnesium-ethyl $Mg_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$ Cadmium-ethyl $Cd_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.$

Organo-aluminium series.

Type $Al_2\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.$ (Example.) Aluminium-ethyl $Al_2\left\{\begin{matrix}C_4H_5\\C_4H_5\\C_4H_5\end{matrix}\right.$

Organo-tin series.

Types $Sn_2\left\{\begin{matrix}Cl\\Cl\end{matrix}\right.$ . . $Sn_2\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.$ . . $Sn_2\left\{\begin{matrix}Cl\\Cl\\Cl\\Cl\end{matrix}\right.$

(Examples.)

Stannous methide $Sn_2\left\{\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right.$ Sesquimethide of tin $Sn\left\{\begin{matrix}C_2H_3\\C_2H_3\\C_2H_3\end{matrix}\right.$

Stannic ethyl $Sn_2\{C_4H_5, C_4H_5, C_4H_5, C_4H_5$ Stannic ethylotrimethide $Sn_2\{C_2H_3, C_2H_3, C_2H_3, C_4H_5$

Organo-bismuth series.

Type $Bi\{Cl, Cl, Cl$ (Example) Bis-triethide $Bi\{C_4H_5, C_4H_5, C_4H_5$

Organo-lead series.

Type $Pb_2\{O, O, O$ (Example) Sesquiplumbethide $Pb_2\{C_4H_5, C_4H_5?, C_4H_5$

Type $Pb_2\{O, O, O, O$ (Example) Plumbic Chlor-triethide $Pb_2\{C_4H_5, C_4H_5, C_4H_5, Cl$

Organo-mercury series.

Type $Hg\{Cl, Cl$. (Example) mercuric ethide $Hg\{C_4H_5, C_4H_5$

Organo-arsenic series.

Type $As\{S, S$. (Example) cacodyl . . $As\{C_2H_3, C_2H_3$

Type $As\{Cl, Cl, Cl$. (Example) Trimethylarsine $As\{C_2H_3, C_2H_3, C_2H_3$

Type $As\{O, O, O, O, O$ (Example) Iodide of Dimethyl-diethyl-arsonium $As\{C_2H_3, C_2H_3, C_4H_5, C_4H_5, I$

Organo-antimony series.

Type $As\{Cl, Cl, Cl$ (Example) Triamylstibine . $Sb\{C_{10}H_{11}, C_{10}H_{11}, C_{10}H_{11}$

Type $Sb\{Cl, Cl, Cl, Cl, Cl$ (Example) Iodide of methyl-triethyl-stibonium $Sb\{C_2H_3, C_4H_5, C_4H_5, C_4H_5, I$

Organo-tellurium series.

Type $Te_2\{Cl, Cl$ (Example) Tellurium-ethyl $Te_2\{C_4H_5, C_4H_5$

Type $Te_2\{O, O, O, O$ (Example) Tellurous oxychlor-diethide $Te\{C_4H_5, C_4H_5, O, Cl$

Our space permits us to give only the above examples of the many organo-metallic bodies which, under their respective types, were printed upon the diagrams hung around the Society's theatre.

Dr. Frankland considers that the law of *conformity of organo-metallic bodies to the normal inorganic types* to be now so firmly established, as to be applicable to the control of the formulæ of organo-metallic bodies that may in future be discovered.

The dependence of the chemical character of a compound upon that of its constituents is interestingly seen in many of the organo-metallic bodies. Thus tribasic arsenic acid, containing five atoms of negative element suffers, by the consecutive introduction of positive radicals, first a diminution of its acid character to a neutral one, and then an appropriation of basic character, till in such a body as the oxide of tetra-ethyl-arsonium we have a substance comparable only with the caustic alkalies themselves.

The Lecturer then elaborately reviewed the doctrine of atomic saturation, as illustrated by the properties of organo-metallic bodies, showing most clearly that, as with all chemical compounds, so with the bodies in question, *each element is capable of combining with a certain limited number of other atoms, which number can never be exceeded*, even though the energy of its affinities may have increased at every successive stage of combination. The relations existing between the maximum points of stability and of saturation in compounds, was pointed out, and the tendency to consider semi-saturated bodies as compound radicals discountenanced, as likely to give rise to narrow and artificial modes of considering and expressing chemical facts.

These views of the constitution and character of organo-metallic bodies was then naturally extended to the organic compounds of carbon. Taking the double atom of carbonic acid as the inorganic type, the substitution of the first atom of oxygen by one of ethyl gives propionic anhydride; the replacement of the second atom by hydrogen yields propionic aldehyde, the third propylic ether, while if the fourth is substituted by hydrogen, we have hydride of propyl, or if by peroxide of hydrogen, we obtain propylic alcohol. The glycols and the teracid alcohol glycerin are also constructed upon the same type, and many of the organic bodies now usually formulated upon the hydrogen, water, and hydrochloric acid types, would be much better expressed upon the carbonic acid and carbonic oxide types.

The application of the above law will be found equally truthful on referring the organic compounds of hydrogen, oxygen, or nitrogen, to the respective inorganic types of those elements. The formulation of organic compounds is not a matter of indifference even to the chemical investigator, and therefore every mode of expression founded upon broad chemical relations ought to have the preference over more purely artificial methods.

TECHNICAL CHEMISTRY.

On Oxalate of Cerium, by FERD. F. MAYER.

THIS preparation, heretofore a *rara avis* even in a chemical laboratory, is now coming into use as a remedy for obstinate vomiting in pregnancy, for which purpose it has been highly recommended by Professor Simpson of Edinburgh. It is given in doses of from one to two grains, in the form of pills, three times a day, and is said to require but a very few doses to give relief.

It is safe to say that the oxalate of cerium, or any other preparation of this metal, has been seen but by few of our pharmaceutists, and that the formulas for their preparation, as contained in the text and handbooks, including Gmelin, will not produce a pure compound, nor is the material from which the metal is to be obtained to be had every day.

Cerium occurs principally in two minerals, one of them, *Cerite*, found exclusively in Sweden, the other, *Allanite*, found in the State of New York. The processes for the preparation of the oxalate are tedious enough to excuse me from recounting the various methods given elsewhere, and I will at once proceed to give what appears to me the most expeditious and satisfactory.

Professor Simpson does not state expressly whether the oxalate of cerium he uses is that of the protoxide or peroxide, but I judge it to be the former, from a sample of the Edinburgh preparation, which, by the by, contains a considerable proportion of *lanthanum*, a circumstance which may have no bearing on the action of the medicine.

The mineral commonly used, and the one I obtained for this purpose, is *Cerite*, a basic hydrated silicate of the

cerium metals (cerium, lanthanum, and didymium), with small portions of lime, iron, magnesia, yttrium, copper, bismuth, molybdenum, and phosphoric acid. The oxides of the cerium metals amount to 67 per cent. of the whole, that of cerium making up about three-fifths of that proportion.

This silicate is reduced to very fine powder, placed in a comparatively capacious porcelain dish, and with strong oil of vitriol, by the aid of a porcelain spatula or glass rod, formed into a paste. The dish is then put over a lamp or sand bath, and heated until the mass ceases to swell up, and no longer absorbs any oil of vitriol, which latter must be added very cautiously to prevent accidents. When this reaction is over, and the mass, now a greyish cake, is cooled, it is to be dried and powdered, and placed in a Hessian crucible, in which it is exposed to the heat of a furnace until it has assumed a pale brownish-red colour. It is now lixiviated with hot water, and subsequently with dilute nitric acid, and the solution treated with sulphuretted hydrogen to precipitate the heavy metals (copper, bismuth, molybdenum). To the clear liquid some hydrochloric acid is added (enough to hold in solution the oxalate of lime, &c.), and a solution of oxalic acid, which precipitates oxalates of protoxide of cerium, and of oxide of lanthanum, and didymium in form of curdy flakes, which soon fall to the bottom as a pale pinkish crystalline powder. This is washed with warm water, then transferred to a mortar, and formed into a paste with one half the weight of the mineral in carbonate of magnesia, which paste is dried on a porous fire-brick, then rubbed fine, and calcined in an open fire until the powder has assumed the colour of cinnamon. In this condition it contains all the cerium in the form of peroxide, which readily dissolves in concentrated nitric acid, carefully to be added in a beaker, to prevent loss by effervescence, and heated by the water bath. This solution is freed, to some extent, of the large excess of acid by evaporation in the same vessel, and after due dilution with some water is poured into a vessel containing *boiling* water, to which a little more than ½ per cent. of oil of vitriol has been added. There should be about a quart of water to every ounce of the mineral worked. When the cerium metals in solution are thus brought together with dilute sulphuric acid, a yellow precipitate of basic sulphate of the peroxide of cerium —2 $Ce_2 O_3, SO_3 + 6$ Aq—is formed, while a little of the neutral sulphate of the same oxide, and all the lanthanum and didymium, remain in solution.

The yellow basic sulphate soon settles when the vessel is removed from the fire, and is washed by decantation with hot water acidulated by the same proportion of sulphuric acid. When thoroughly settled, the precipitate dissolves readily in stronger sulphuric acid, forming a yellow liquid which contains only peroxide of cerium. This I reduce to protoxide by digesting it with a few crystals of hyposulphite of soda, of which it takes but little to remove the yellow colour of the cerium salt by the sulphurous acid disengaged. The liquid is then filtered, and the oxalate of the protoxide of cerium precipitated by oxalic acid, washed with warm water, filtered and dried.

The dilute solution of the cerium metals in sulphuric acid, and the washings from the precipitation of the basic sulphate, retain a considerable portion of persulphate of cerium, which is obtained for the greater part by evaporation of the fluids to one-half. If reduced to a less bulk, sulphates of the other metals will crystallise out, which can only be separated by again precipitating a basic persulphate of cerium as described above.

Oxalate of the protoxide of cerium is a snow white powder, and consists of $2\,CeO + C_4O_6 + 6HO$ =

46·14	CeO
30·78	O
23·08	HO
100·00	

It is insoluble in water, but dissolves in sulphuric acid, by which it is distinguished from other insoluble salts of the earths, and its solution yields a precipitate with caustic alkalies even in presence of chloride of ammonium, which is not soluble in an excess of the precipitant.

PHARMACY, TOXICOLOGY, &c.

Chalybeate Cod Liver Oil.

We find in the *Répertoire de Pharmacie* for this month, a formula for the easy preparation of chalybeate cod liver oil, which the author, Dr. Jeannel, thinks will be found useful, now that the remedy has become an established therapeutic agent. He takes :—

Brown cod liver oil . . } Distilled water . . . }	of each 8 ounces.
Carbonate of soda (crystallised) .	3½ drachms.
Sulphate of iron „ .	3 drs. 2 sc.

The sulphate of iron and carbonate of soda are dissolved separately in distilled water; the solutions are then poured together and added immediately to the oil. The mixture is kept in a bottle with a wide mouth open to the air, and repeatedly shaken for eight days, after which the oil is separated from the solution of sulphate of soda and filtered. The above formula, the author says, appears to be the best for obtaining a beautiful and uniform product. It is perfectly clear, of a pomegranate red colour, and neither the taste nor smell is more disagreeable than that of ordinary cod liver oil. Out of contact with the air it may be kept without alteration, but when exposed it quickly becomes rancid, and even resinifies in a short time. It contains about 1 per cent. of the sesquioxide of iron.

Improved Taste to Cod Liver and Castor Oils. — Dr. Jeannel, in another communication, gives the results of some experiments he has made to overcome or remove the disagreeable smell and taste of the above oils. He has found that a few drops of the essential oil of bitter almonds will completely mask the nauseous fishy smell and taste in some ounces of oil. The exact quantity required varies of course according to the fetidity of the oil.

Cod liver oil, shaken up with an equal volume of laurel water and left to rest for 48 hours before separation, acquires by this simple operation an extremely sweet perfume and agreeable taste of almonds; the taste remains in the mouth as long as the digestion lasts. Oil flavoured in this way could be taken by many patients who rejected it in the natural state.

One drop of the essence of bitter almonds will communicate an agreeable taste and smell to an ounce of the castor oil of commerce, and will not at all affect its purgative action.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On Food, by Edwin Lankester, *M.D. F.R.S.*

Lecture I. *On Water.*

The object of the course of lectures which I commence to-day is to bring before you the principal forms of the substances of which we partake from day to day under the name of foods, by means of which we live, and without which we should die. Man is like a fire. In order that he may live, as the fire may burn he must have fuel he must have food. And the analogy is in many respects quite correct, for we find that man really produces in his body a certain amount of heat, just as the fire gives out a certain amount of heat, as the result of the combustion of the materials with which we are supplied — so that man exists in consequence of the physical and chemical changes that go on in his body as the result of his taking food. One of the most important of the results of his taking food is, that his body, which is destroyed from day to day by the processes and the wear and tear of life, is kept up and maintained of a given bulk. Thus we find taking a man weighing 154 lbs. that he would lose in the course of a day from three to four pounds of matter in the various exertions which he makes in life. Now this matter must be supplied in order that he may remain the same. Then, again, as I said before, man's body is heated up to a given temperature. If we take a thermometer and put it under the tongue and compare it with the atmospheric temperature we shall find a difference — we shall find that the thermometer will stand at 98° in the human body, whatever may be the external temperature; and this is the result of the quantity of food which we take being burned up, consumed in the system. There is then a double object in taking food: first, nourishing the body, and, secondly, maintaining the heat of the body. We shall find, however, that although these processes are the principal ones that go on they are attended by others.

We divide food into two great groups. Into that which is necessary from day to day and without which we could not live, and that which acts rather as a medicine—as an auxiliar. Taking the first group of things—the water — we cannot do without water, we must drink, and thus it becomes a necessary of life.

Among the auxiliary things we place spirits, wine, and beer, tea, coffee, and cocoa: these are not absolutely necessary to life, many persons live without them. And this even holds good so far as medicine is concerned; for we often treat disease by supplying or withdrawing food. When a person's brain is failing we give him nourishing food, and in other cases we give him low diet; and stimulants, such as ammonia, sal-volatile, and things of that kind are administered as auxiliary foods. Now medicine and food are more allied to each other than most persons think, and we constantly administer medicine in the form dietetics.

In the present course I propose to treat of the group of necessary foods; and first of water. We find that water constitutes the greater part of the beverage we take from day to day. When we take beer we take a large quantity of water. When we take tea or coffee we take water.

In many respects water more closely resembles nutritive food than it does the heat giving food; that is to say, it more closely approaches in its relation to the human system the character of meat than it does the character of starch or sugar; and for this reason, that it combines with the body and constitutes a necessary part of it. Thus a human being that weighs 154 lbs. contains 111 lbs. of water in his body. You see then that the water is necessary.

Before speaking more particularly of this water, I will call your attention, in the first place, to its composition. It is not my province to dwell on the elementary composition of food any further than to threw a light on its action. Water then is composed of two gases, one called oxygen and another called hydrogen, and we can easily decompose water so as to demonstrate its composition, or produce it by combining the two elements.

And now I must speak of it in relation to the life of animals and plants. No animal and no plant exists without certain quantities of water. Sometimes it is so large in quantity that it constitutes the great mass of the animal or plant. Thus, taking some plants that grow water, we find that they are formed of from 90 to 95 per cent. of water, and many of the little animals contained in water, if we take them and put them over the fire to evaporate, their water entirely disappear. Even solid timber contains as much as 30 per cent. of water. Plants will not live without water. If we refrain from supplying them with it they die. The water passes in at their roots and up their stems and through them out at their extremities or leaves as the sun dries them or evaporates their moisture. The water contains their food, carbonic acid gas, and ammonia. Those two substances pass into the plant, and out of those two substances we have manufactured in the system of the plant all our vegetable food, and it goes into this food by the agency of water. Carbonic acid gas and ammonia, then, are the food of man, and out of the four elements carbon, oxygen, hydrogen, and nitrogen, are formed the food of man. I told you just now that the human body weighing 154 lbs. contained 111 lbs. of water, but there ore some animals of the lower scale containing larger quantities than this. Thus Professor Owen weighed one of those singular animals called jelly fish, and found it weighed six pounds, and when dried it weighed only sixteen grains. So that you will see this great mass of six pounds was actually water organised by sixteen grains of solid matter. If we look at the tissues of animal bodies we shall find that large quantities of water are contained in them. Then you see this water which is contained in animals is constantly liable to evaporation, and that the mass of the body is constantly losing its moisture, which therefore must be supplied. Now then we find that water is contained in our food entirely and quite independently of our supplying it in a purely liquid form. Let us take, for instance, the potatoes. The flesh-forming matters in potatoes weigh two pounds in 100, and the heat giving matters weigh 23 lbs. so that we get 25 lbs. of solid matter. All the rest is water. When you purchase 100 lbs. of potatoes you do not purchase 100 lbs. of solid material, but 74 lbs. of water. Now I will draw your attention to the great importance of understanding the fact that certain forms of solid food contain but very little water, and other forms contain a great deal. Thus, for instance, those who take potato diet, such as the Irish peasantry, require little water. A very curious fact took place during the famine of 1847. The Irish, when the potatoes fell short, ate Indian meal and rice, and therefore lost a quantity of water to which they had been accustomed in their potatoes, and then they took tea and coffee, to which they had not been accustomed before; and they took this tea and coffee, it turned out upon investigation, for the purpose of supplying the necessary water to the system. In rice instead of having about three-fourths of water as in the potato you have only an eighth; and we have just about the same proportion in beans and barley. But in the cabbage, and the parsnip, and the turnip, and the carrot we have even larger quantities of water than in the potato, thus accounting for the comparative inutility of carrot, cabbages, and potatoes as foods when compared with beans, peas, and other materials with which animals are fed. Then with regard to the beverages which we take, such as tea and coffee, we find that the greater portion is water, and table-beer, which is much the best, contains no more than half an ounce of alcohol in a pint, the rest is water, while the strong pale ales and stout contain only two ounces of alcohol. In the case of those French wines which we shall have in under the lowered duty, very few of them contain more than two ounces of alcohol in a pint of twenty ounces. Even our ports and sherries, brandied as they are, contain as much as twelve of fourteen ounces of water in the pint. Now

the action of water on food is very important. I may say that there would be no carrying of food into the system but for the agency of water. It dissolves everything that we take, and nothing that we take as food can become nutriment that is not dissolved in water. It would not do to test that by taking things and putting them into water and seeing whether they dissolve, and rejecting them as food according to that circumstance, because food undergoes a considerable change in the stomach. It undergoes a change, to begin with, in our mouth; one of the great objects of that change is to render things which had been before insoluble in water soluble. A starch which we cannot dissolve in water out of the stomach is dissolved by water directly it gets into the stomach, because the starch is changed into sugar, and that which would lie in water for months is so changed by the saliva of the mouth and the pepsine of the stomach that it is dissolved. Then where we are taking considerable quantities of dry food it becomes absolutely necessary that we should add a certain quantity of water so that this dry food may become dissolved and enter into the system.

Now let me call your attention to the sources of water as drunk ordinarily for the purpose of diet. People are generally very indifferent about water, and perhaps it arises from the fact that taking it as tea and as beer makes us independent of simple water. At the same time I do not think it is wise to be constantly taking water with other things added to it, and for this reason that the water gets its soluble powers interfered with by already having things in solution. Thus a pint of beer will not dissolve so much of the starch or digested meat as water. So with regard to the food which is digesting. It is better that we should throw upon it sometimes cold water than hot water, which contains a variety of substances in solution. I am not advocating that people should give up tea and coffee, beer or wine, but the necessity of taking cold water daily as pure as it can be had; therefore, it becomes a matter of importance to ascertain whether the water which we take is pure.

Now there are many sources of water. The first and largest you know is the ocean, which collects all the water from the earth; but this water contains a large quantity of salt, and none of us can drink it. The heat of the sun, however, falling upon the surface of the ocean penetrates the water, and, as it were, combines with the water, and raises it up in the form of vapour. And the atmosphere, like a sponge absorbing the water, carries it from the equator to the Arctic and the Antarctic regions, and distributes it north and south; and then it condenses in the form of rain near the surface, and in the higher regions of the air in the form of snow pouring down to the earth, and at last running back to the ocean in the form of rivers.

The purest water that we have in nature is rain water; but in large towns it becomes contaminated with sulphuric acid and ammonia, and the unconsumed carbon or soot, as it runs over the roofs of the houses; still where rain-water can be collected in the open country there is no doubt that it is the purest form of water. It is, however, on spring and on river water that we are most dependent, and therefore it is to these I shall more especially call your attention. There are two kinds of well or spring waters which are consumed in London, the surface well waters and the deep well waters. If you dig twenty feet or twenty-five feet in some parts of London you get plenty of water; but if you want to get pure water you must dig down to the chalk. Many persons suppose it is a matter of indifference whether they obtain their water from surface wells or deep waters. If the surface well waters are so pure and so delicious as many people endeavour to make out, why have the brewers dug so deep into the chalk? Why we shall find that these surface well waters are charged with all the impurities of this gigantic city. The gravel underneath us is everywhere charged with all kinds of impurities and refuse, and as the rain descends upon it all these are washed into our spring waters. Then there is the river waters as a source for those who have not the surface water, or deep artesian wells. Now rivers contain a considerable quantity of animal life. I need not tell you that small crustacea and zoophites and many microscopic plants abound in river water, which we do not find in pure spring or in deep artesian well water. The deep well water is free from all such contaminations. River waters are less pure because of the organic life which they support. There is also another source of impurity in the river water. Our lands and farms are highly manured, and the manure flows from these lands, and the water passing over them carries the constituents of the manure to the river, which therefore makes the river waters to some extent objectionable. Now I want to draw your attention generally to the contents of these waters, and to show you the action of the impurities. I do not know whether it is correct to say that the saline matter is an impurity. Our own blood contains 420 grains of saline matter in a gallon. Now if a physiologist were to say that that was an impurity in the blood he would be laughed at for the absurdity. Therefore if spring water has it, it is of necessity, and it has never been proved, at any rate, to do any harm. It is only when these matters are in large excess that they are likely to prove injurious. We can get more saline matter into the blood than 420 grains to the gallon, and it would then become injurious. There are two kinds of substances in water which are called generally injurious; the first consists of saline substances like common salt, carbonate of soda, and sulphate of lime; those are things which are called saline impurities. Sometimes those saline properties increase so largely as to become medicinal, as in the waters of Leamington, Harrowgate, and some other places. There are also certain gases contained in water. First, there is carbonic acid gas. Now this gas accumulates in quantities in some waters such as the waters of Carlsbad and Seltzer. It is not contained in so large a quantity in our river waters as in our well waters, for when water is exposed to the atmosphere the carbonic acid escapes. Then there is sulphuretted hydrogen gas, which is a very disagreable gas when it comes in contact with the human nose. Water passing over sulphide of potassium in any district would take up and retain sulphuretted hydrogen, and this is what constitutes sulphuretted springs or sulphureous springs in various parts of the earth. It is not unnecessarily indicative of unhealthy water. Though indicative of impurity it is not itself impure. In many large manufactories many men work and breathe all their lives sulphuretted hydrogen. It is the substance which is decomposing, and which gives off this gas, which is impure. The fact is seen in persons drinking and consuming very considerable quantities of sulphuretted hydrogen waters at the watering places.

Now we come to the saline ingredients. There is one carbonate of lime or common chalk. This carbonate of lime is dissolved by carbonic acid, and that is why I dwell on the carbonic acid. Now waters may get charged with carbonic acid gas from two sources, first from the earth, and secondly from the decomposition of animal and vegetable matter. Those surface well waters are constantly charged with carbonic acid gas, especially near a churchyard, where the animal matters are continually giving it off. I have heard it observed that the most popular well in a parish is always that one which is nearest to the churchyard. I know how popular the well is by the church of this parish, and the Broad Street water, I remember, on the 1st of September 1854 and three following days killed 700 people of cholera, and still that water is very popular. It contains a large quantity of carbonic acid gas. It is more sparkling and seems to taste more lively and pungent. The carbonic acid unites with the lime, and in that way a much larger quantity of lime is kept in solution than would be held if the water did not contain carbonic acid. Now a large quantity of carbonate of lime in water is highly objectionable. It makes the water very hard, and you know that a very hard water is not the best for cooking, and is unpleasant and expensive for washing. Happily we have a very easy means of getting rid of this soluble carbonate of lime. By adding more lime we

can take away the carbonic acid, and then the chalk which it held in solution is precipitated. Now that is the process of Dr. Clarke of Aberdeen; he recommends us to put in what he calls the cream of lime, when by taking up the carbonic acid gas the carbonate of lime is thrown down, and you get rid of it in the form of chalk. In this way you may get rid of not only the carbonate of lime, but also a quantity of impurities which are carried down with it. Now carbonate of lime is objectionable in water in many respects. First of all it sometimes indicates that water contains carbonic acid gas which has been obtained from decomposed animal matter. It also renders the water hard, and so compels us to use a larger quantity of soap in washing than would be necessary if the water were softer. Besides this a very hard water is not so good for making tea and boiling vegetables with as a soft water, so we have large manufactories for softening water. There is another substance which affects water, sulphate of lime, which is a very objectionable ingredient in water.

Then there is an important substance called chloride of sodium, which can only come to the surface wells by the fact of the salt being constantly used by man in cooking, and thus passing into the sewers. A very little chemistry will enable an intelligent person to detect these impurities. The sulphuric acid of the sulphate is at once detected by nitrate of baryta which forms with it a white precipitate. The presence of the lime also is shown by its giving a white precipitate with oxalic acid or oxalate of ammonia. Chloride of sodium is detected by nitrate of silver which forms a white precipitate of chloride of silver. And if you want to know the whole quantity of impurities which a water contains you have only to evaporate a given bulk to dryness and weigh the residue.

Now I want to speak of the organic matters which are either living or dead. These are very disagreable constituents of water. They are sometimes found in very large quantities. Living things are not so objectionable as the dead. I believe it is a much more healthy practice to swallow oysters while alive than to wait until they become putrid; and that is just the difference. There are a variety of forms of these living things, and when water is tolerably well filtered and brought to a house it still contains a great many.

The dead matter is of two kinds. It is either dissolved and you cannot see it under the microscope, or it is seen under the microscope to consist of the *débris* of animal and vegetable life. Now dead matter in two or three days begins to putrefy, and if you take this putrefying matter into your stomach it will make you ill. I had a very singular fact mentioned to me not long since when lecturing at the Royal Institution upon bread. I was told that you could not, last summer, make aerated bread without its becoming stickey, and the process of fermentation starting off in it after the bread had been made. Dr. Dauglish, the patentee, was puzzled at this fact, and he could not conceive any cause for it, but that it must be in the water from Dockhead. He therefore determined that he would boil it. He did boil it, and then the water became pure, and the bread resisted the action of decomposition. When the organic matter is dissolved you can test it with the permanganate of soda or potash, which will be quickly decolorised if the water contains much of the organic matter.

There is one important thing which I cannot enter upon at any length. Where the water is pure, free from saline matter and with but small quantities of organic matter, it acts upon the lead pipes and cisterns. This is the case at Manchester and Liverpool where they have good water from the highest localities, and it will act upon the lead. The people of Manchester and Liverpool will not believe this because they have paid so many hundreds of thousands of pounds in purifying their water, and yet they are constantly having attacks of colic, and get blue lines around their gums indicating that lead is acting upon their system. There the water is stored in leaden cisterns. I have never been able to detect the action of Thames water on the lead. Why? The small quantity of saline matter which is there really seems to prevent the lead from entering into the composition of water and making it poisonous.

SOCIETY OF ARTS, *Wednesday*, 30 *May* 1860.

THOMAS SOPWITH, *Esq. in the Chair.*

AT this the last ordinary meeting of the present season Mr. G. P. BURNELL read a paper *On Building Woods, the Causes of their Decay and the Means of Preventing it.* After some introductory remarks and botanical definitions Mr. Burnell pointed out the injuries inflicted on timber trees by frost and lightning and those occasioned by local decomposition of the sap. He then proceeded to notice the various insects destructive to timber trees. Next followed an account of the trees generally employed in this country for building purposes, with none of which particulars we need trouble our readers.

Mr. Burnell next considered the destructive effects of dry rot which is thought to arise from the development of various fungi, viz. according to Dr. Birkbeck, the *Boletus Agaricus*, *Lycoperdon*, &c. Wood under the influence of the dry rot is converted into a friable sort of sponge which the mere contact of the finger will crumble away. As regards other agents of destruction the lecturer said:—

"The insects which prey upon growing timber very rarely attack the qualities of wood used for constructive purposes. There are, however, some insects which prey on what may be called dead timber, such as the *Lymexylon navalis*, the *Sirex gigas*, the *Callodium bajulum*, and the various tribes of ants. At times their ravages are very serious, especially in the case of oak timber stacked in large quantities, and of all descriptions of wood in warmer climates which is exposed to the attacks of the destructive termites, or the white ants. In sea water there are two species of insects which commit great ravages, viz. the *Teredo navalis* and the *Limnoria terebrans*; and they devour indistinctly the alburnum, or the heart wood, with such rapidity that in a very few years large sticks of timber, whole piers, in fact, are destroyed by them. It is said that the *teredo* was imported into the seas of northern Europe by the Dutch, from their colonial possessions, about the middle of the seventeenth century; but I suspect that there is little reason for this opinion, and that the *teredo* has been a constant inhabitant of our coasts at least from the time of the deposit of the London clay. About 1660, however, the safety of Holland was seriously compromised by these animals, and since that period the attention of engineers and naturalists has been earnestly and anxiously directed to the study of the best method of combating this apparently insignificant enemy. The habits of the *teredo* have thus been carefully studied; but those of the *limnoria* are not so well known.

"Of these causes of decay it is singular that the most general and the most fatal, viz. the wet rot, has attracted less attention than the more startling, but less common, evils — the dry rot, or the destruction by insects. The methods of prevention and cure for either of the rots are, however, fortunately nearly the same. Great precaution should be taken to ensure a perfect circulation of air and a freedom from moisture, to all unprepared timber, let it be ever so sound, free from sap, druxy knots, star, cup, or ground shakes. If for constructive purposes it be necessary, however, to use timber in the above dangerous positions, some one or other of the processes for resisting the chemical changes in the tissues of the wood must be resorted to. These processes are all founded on the principle that it is essential to inject some material which should at once precipitate the coagulable portion of the albumen retained in the tissues of the wood in a permanent insoluble form, which should not hereafter be susceptible of putrefactive decomposition. For this purpose many substances, many solutions have been employed with variable success, of which the most important and the best known are: 1. Kyan's patent, or the injection of a solu-

tion of the chloride of mercury. 2. Margary's process, or the injection of a solution of the sulphate of copper. 3. Sir W. Burnett's process, or the injection of the chloride of zinc. 4. Payne's process, or the production of a double decomposition in the pores of the wood, by firstly injecting a metallic solution, such as the sulphate of iron, and then injecting a second solution, such as the carbonate of soda, which would form an oxide of iron in the cellular tissues. 5. Bethell's process of kreosoting, or the injection of the heavy oil of tar; and Boucherie's process, which is, perhaps, rather a modification of the manner of injecting the sulphate of copper than the application of a new solution, although he occasionally uses the chloride of calcium and the pyrolignite of iron. The experience furnished by the railway system, and the various hydraulic works of our own and foreign countries, appears to me to have shown that the efficacy of those various processes may be described as follows:—The kreosoting one is the most generally successful; the application of the sulphate of copper is successful in many cases; the other processes, although no doubt of occasional value, have practically been abandoned. It will therefore only be necessary to revert to the kreosoting process and the use of the sulphate of copper.

"Now, the application of any of the aqueous solutions of mineral salts as a preservative process seems to me to be of limited benefit in cases where the wood is exposed to the action of frequently renewed water, for it has been proved, practically, that the combination between the salt and the albumen is not sufficiently permanent to resist the long continued solvent action of such water. For pier, bridge foundations, or dock work, or even for railway sleepers, I myself should hesitate to use any of the mineral salts; but for house-building purposes, I think that there cannot be any reasonable doubt of the beneficial effects of the application of the sulphate of copper for the prevention of rot in its various forms, and I should decidedly recommend its use for the timbers of ships not immediately exposed to the action of the water, whether the timbers be, or be not, seasoned. It is also to be observed that the solution of the sulphate of copper does not communicate any disagreeable smell to the wood, an objection which applies forcibly to kreosote, and the former process may, under such circumstances, be adopted for domestic purposes. The proportion of the sulphate of copper in the solution, should be 1 lb. of the salt to 4 gallons of water.

"In addition to the objection to the sulphate of copper, and the other metallic salts on the score of their solubility in running water, there is this peculiar objection to them in the case of timber used in sea water, viz. that the action of the albumen in the wood renders them perfectly innocuous to animal life, however poisonous they might originally be. Woods thus treated are not, then, in any way protected against the timber destroying insects, whereas it is certain that the injection of kreosote is a most effectual protection against some of those creatures; for you may observe that, in the section of a pile exhibited, the teredo has gone out of his path to avoid the portions of the wood impregnated with that substance. In India it seems also that the white ants have a dislike to kreosote, and they avoid wood which has been prepared by its injection; so that inasmuch as the experience of nearly twenty years has shown that the ordinary causes of decay are arrested by this process, and that it affords an effectual protection against many timber destroying insects, it seems to me that wherever the peculiar odour of the kreosote does not constitute an objection to its use it should be applied. I beg, however, distinctly to call attention to the fact that I do not assert that kreosote will protect wood against all descriptions of boring worms, for samples of wood said to have been kreosoted have been occasionally shown which exhibit traces of the ravages of the *Limnoria terebrans*. I think that much reason for doubt exists on this matter, because in far too many cases the kreosote used has been of inferior quality, and in many others the pyrolignite of iron has been substituted for it. I have not been able yet to analyse the samples of the prepared and unattacked woods I have seen, but I am very strongly inclined to question whether any authenticated cases of the failure of kreosote really exist. The asserted fact of the attacks of limnoria is, however, a very remarkable phenomenon under any circumstances, and it merits very serious inquiry by our scientific and technical bodies. If the pieces of wood in question were really kreosoted, it would seem to prove that the material which is distasteful to one animal may be attractive to others, and therefore that the green heart timber which is said on a very doubtful authority to be protected from the teredo by the essential oil it contains, may be exposed to destruction from the *limnoria*, or from the land insects I have myself noticed in it. If the piece of wood just referred to were prepared by the injection of pyrolignite of iron, it would equally seem that that ingredient is no more able to protect wood against insects than it is admitted to be able to protect wood against rot or decay. There are several very obscure points connected with the habits of the marine boring worms which I am at present studying, and I hope, at some future occasion to be able to dwell more at length on the subject. My present impressions are that these dreadful pests are have peculiar habits, that is to say, that they respectively select the localities for their residence on account of some peculiarities in the chemical composition of the materials of the sea shore, and that they have peculiar and distinct tastes, so that the immunity from the attacks of one of these classes of insects, does not necessarily imply immunity from the attacks of others. But as the teredo is the most destructive of the marine, and the white ant the most destructive of the land devouring insects, it seems to me that the process of kreosoting (which is now generally admitted to be an effectual protection against both of those enemies) should be adopted in all cases where wood is likely to be exposed to their attacks. That kreosote is able to protect wood against ordidary decay is proved by the state of the sleepers of some of our railways, laid down as far back as 1841, but of course this process, like all practical chemical ones, requires to be applied skilfully and conscientiously. In the best kreosoting works, such as those of Mr. Bethell, or the still more extensive ones of Messrs. Burt and Co. the oil is injected at a temperature of 120°, and under a pressure of 150 lbs. on the square inch, so that ordinary fir timber absorbs on the average from 8 to 10 lbs. weight of the kreosote to the cubic foot. For all building or hydraulic engineering purposes, fir timber thus treated is far more durable than the best oak, teak, or other hard woods, and as the cost of the operation is very small, it certainly should be resorted to on all occasions where the smell of the kreosote is not likely to be objectionable. When this is the case I certainly think that some modification of Margary's process should be adopted, and that house or ship timber sexposed to damp, warm, and confined air should be treated with the sulphate of copper."

Mr. P. H. Burt opened the discussion, and in the course of his speech said that the preservative processes of Margary, Sir W. Burnett, and Payne were now nearly obsolete. He had prepared timber by all the known processes, and nothing had equalled the kreosoting method, as described by Mr. Burnell; timber which had absorbed 8 or 9 lbs. of kreosote per cubic foot.

Mr. Robert Davison considered the best mode of preserving wood was by injecting kreosote. He thought too that timber ought to be dried, imitating nature by rapid currents of heated air; his plan was to send air through the timber at about 48 miles per hour, at a temperature of 110° or 112°; Honduras mahogany would stand 300°.

Mr. C. H. Smith said that kreosoting was a very close imitation of nature — the heart-wood, especially of the fir tribe, was full of turpentine, which was not therefore so liable to decay, and in the artificial processes kreosote best supplied the place of the natural resin.

Mr. Bethell added his testimony to the preceding in favour of kreosote, and considered the durability of the green-heart teak and pitch-pine timbers to be entirely owing

to the hydrocarbon or oil they contained. Firs which had been tapped for their tarpentine yielded far less durable wood than those where the resin was left in. He considered that 10 lbs. of kreosote per cubic foot was the proper quantity. He had found that the quick-drying process named by Mr. Davison caused the timber to split.

Mr. Davison replied that about a hundred specimens of wood were submitted for experiment by Mr. Chatfield under the direction of the Admiralty, not one of which had split under the drying operation.

Mr. Wentworth L. Scott said that the preservative processes described might be divided into two classes — viz. the impregnation of wood with chemical salts, so as to coagulate the juices and inject a substance poisonous to insects; and 2ndly, the use of volatile antiseptic principles, such as kreosote. He should be glad to hear from any gentleman practically acquainted with the subject whether any experiments had been made with oxidising agents such as the permanganate of potassa, and picric or carbazotic acid on a large scale. He had found a dilute solution of the acid, even 20 to 24 grains per gallon of water, preserve wood admirably, and arrest its decomposition when half decayed.

Mr. Bethell said he had not heard of the agent named by Mr. Scott being commercially employed.

After some remarks by the Chairman, a vote of thanks was passed to Mr. Burnell, and shortly afterwards the meeting separated.

HOUSE OF LORDS, *Thursday, June 21.*

Adulteration of Food or Drink Bill.

The House went into committee on this Bill.

On clause 1,

Lord Teynham said that as this clause now stood the Bill, which was of great importance, would become an entire nullity. In order to convict it would be necessary to prove that the article was adulterated to the knowledge of the seller. Now it would be practically impossible to prove this knowledge. Take the case of milk. It was not too much to say that the lives of many of the infants of the poor were sacrificed owing to the adulterations in this commodity; but if the vendor were allowed to say, "I know nothing about the adulteration, I sell my milk as it was given to me," it would be impossible ever to bring home the charge either as to this or other articles. At the present moment, when provisions were so dear, it was of great importance that a poor man's family should receive the whole amount of nourishment they expected for the money which they expended. It was said that the vendor might really be ignorant of the adulterations, but he maintained that a shopkeeper ought to have some knowledge of the quality of the articles he was selling, and in any case the amount of the penalty inflicted might vary according to the circumstances. The noble lord concluded by proposing an amendment to omit the words as to the knowledge of the seller, and extending the operation of the clause to other adulterations than those contemplated by the Bill.

Lord Wensleydale said the committee on this subject had agreed in recommending that the Bill should be confined to adulterations which were prejudicial to health, but the amendment would render penal any admixture of foreign ingredients in articles sold. Now, he thought it would not be right to extend the operation of the Bill so far as this. It would be rather hard, for example, to inflict a penalty upon a milkman who had poured a little water into his milk. He thought also that a guilty knowledge should be essential to any conviction. It was possible that the article adulterated might have been bought from the wholesale dealer and sold without any fraudulent intention, in which case it would hardly be right to convict.

The Lord Chancellor also opposed the amendment. The wholesome maxim of the law was—*actus non facit reum nisi mens sit rea*, and this should not now be departed from. Proof of the *scienter* was essential to constitute the legal offence.

The amendment was then negatived, the clause was agreed to, and the Bill passed through committee.

CORRESPONDENCE.

The Mathematics of Chemistry.

To the Editor of the Chemical News.

Sir,—The individual who directs his attention to that department of philosophy which is included under the term chemistry, has *par excellence* to do with the nature and structure of bodies; and here, for want of experience, he soon finds himself lost in speculation, having gone as far as the experience possible to man in the present state of science appears capable of leading him, and thus having neared if not reached the boundary beyond which the real knowledge of facts, as distinguished from queries merely concerning them, is never looked for by any person who understands the Baconian method of discovering physical truth, which, it is almost needless now to remark in connection with the physical sciences, is the only method competent to this end.

Taking physical atoms in whatever sense we may, every individual must, I think, allow it to be absolutely inconceivable, that any atom can become any other, either of a similar or different kind: the transmutation of physical atoms appears to me to be a phrase having no meaning, whether these are individually or collectively considered. In the latter case this is even popularly evident, no person ever imagining that his chairs or tables could by any means become different objects. This being granted, we are drawn on to another consideration. The world presents an immense variety of objects, and therefore it is the conclusion of those who are not at the pains to institute a rational inquiry before forming their opinions, that there are many species of matter. This notion, as everyone pretending to the least tincture of scientific acquirement knows, is at once greatly modified by chemical analysis, which reduces us to a few so-called elements, which bodies have received this term because it is not known that they are capable of further simplification by man. Now although we may never be enabled experimentally to prove that many chemical bodies now considered elementary, are really compounded, yet I maintain this cannot be said to prove that there are many species of matter, apart from all variety of structure or arrangement. Whether or not matter is anything apart from its modes, we are sure that we can become acquainted with it only by its modes or forces. I strike my hand upon the table, and find a strong resistance: hence I affirm that resistance is one of the modes of matter, although it is not clear whether matter is anything apart from the passive power experienced. Supposing matter to exist as such, it is clear that the various forces with which it is connected would cause man to imagine that there are many species of substance, whereas all matter is similar, and the differences apparent are owing to the various forces with which it is furnished, and which arise from diversity of structure or arrangement: and if what we term matter is nothing but various bundles of collected forces, then it is comparatively easy to understand how the change of forces in kind and degree effects all those palpable alterations, which come under the inspection of chemical philosophy.

When lime is slaked the watter added to it is said to become solid; but this phrase has really no meaning, although it may practically convey information as to what palpably occurs. Turn it about as we may, we can never make anything of the assertion that water ever becomes solid, for to speak of solid water is altogether inconsistent: such a substance would not be water. It will not be useless to give a little consideration to this matter. When water is mixed with quick lime it disappears as a palpable body: if water is anything apart from its modes the water

unites mechanically with the lime, I say mechanically, inasmuch as all chemical union, which generally, I am here endeavouring to explain, must be mechanical, in the philosophical use of the term, and perhaps acquires new forces; or the heat given out may be owing to the action alluded to. If matter, however, is nothing apart from its forces, these are lost in the operation under consideration, and perhaps new ones are created; this must be the case if the cessation of the former is not sufficient to account for the development of the heat experienced. This phenomenon is popularly termed a chemical one, inasmuch as the various forces cannot be inspected by human ingenuity, at any rate at present; but it is easy to understand that all forces must really be mechanical, which, indeed, the word implies. A difficulty, however, may arise, because in chemistry we are concerned with what is called the creation of substances, but this is only owing to the lumpishness of the human mind: man does so confuse himself with mere words, many of which suggest no, or very incomplete, ideas to the mind. I suppose no person who thinks at all supposes that the phllosopher who engages[1] in chemical researches is the witness of continual creations in the proper sense of the term; but many persons would be surprised if they were told that the production of new bodies by chemistry is just as mechanical as is the production of a watch at the hands of a watchmaker, or of a coat at those of a tailor: the action is different in kind and not in degree. There is nothing mysterious in the production of new bodies by chemistry, using this term in its common meaning: the forces comprehended under this science are, as are all pure forces, if we take matter to be nothing but collections of forces, invisible; and, inasmuch as we have here, as regards the production of new substances, to concern ourselves with elastic and non-elastic fluids, which are things offering but little resistance, the popular idea of chemical action, if it is worthy of the name, is merely a confusion, a notion of something that acts in an occult or mystical manner. Nothing can at first appear stranger than the fact, if such it is, of which there now appears no doubt, that diamond is only crystallised carbon. If matter is anything *per se*, it must be that its structure is changed, and hence that it acquires new forces, the passive operation of which makes us acquainted with it as pure carbon: if matter is only a collection of forces, for I think it right again to adduce this possibility, then those forces which are brought to bear upon the diamond cause these to be supplanted by others, part of which differ from the former in kind and part in degree. Carbon does not reflect the luminous undulations, and thus perhaps, possesses a passive power different in kind from the reflecting power of the diamond, while its resisting force evidently differs from the latter object only in degree, for all variety of resistance cannot imply conditions differing in kind.

It is true that chemistry, especially since the discovery that all bodies unite in definite proportions, has advanced to the position of an exact science; nevertheless, chemical action must to some extent be apprehended, before the various operations performed by the chemical philosopher can come under mathematical or even physical supervision. It is not enough to know that two substances combine in various and of course constant proportions: before these phenomena can be fully described, we must know at least something of the actions of the various forces, as we do in most parts of physics, on account of the magnitude and palpability of the materials under inspection.—I am, &c.

J. A. Davies.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—When I was first engaged in the decomposition of salt, immediately after the repeal of the heavy war tax upon that article, now nearly forty years ago, the composition and combinations of sulphuric acid caused me much perplexity.

I have since come to the conclusion that sulphuric acid exists in two different states — one as liquid acid, in which state it must be considered as sulphur in a high state of oxidation in chemical combination with a portion of hydrogen; the other as dry acid, in which state it is only found in combination with a variety of bases, and must be regarded simply as oxidised sulphur freed from hydrogen.

When sulphuric acid is poured upon iron hydrogen is disengaged; this was the old mode of obtaining hydrogen gas for inflating balloons when they first came into use.

When muriatic acid is poured upon iron hydrogen is also disengaged. It is now more than half a century since Sir Humphry Davy discovered the true nature of muriatic acid. He found it composed of a peculiar body, which he named chlorine, chemically combined with hydrogen. Since that time all the compounds formerly termed muriates are now considered as chlorides, and the acid is changed to the hydrochloric. There seems something analogous between sulphuric acid and the muriatic or hydrochloric acid, only in the sulphuric acid there is a compound of sulphur and oxygen while in the muriatic there is chlorine, hitherto regarded as a simple body.

Salt is decidedly a chloride of sodium; when acted upon by sulphuric acid muriatic is given off, the sulphuric acid furnishing the requisite supply of hydrogen for converting the chlorine into muriatic acid.

Let us now consider what takes place in the ordinary mode of forming sulphuric acid. I give the following merely as my own private opinion. The fumes of burnt sulphur mingled with a small proportion of nitrous acid enter the vitriol chamber where they meet steam or water. The nitrous acid parts with its oxygen to a portion of the sulphurous vapour. A little water is decomposed. The hydrogen of the decomposed water combines with the highly oxydised sulphur which is condensed into liquid acid. The oxygen of the decomposed water unites with the nitrogen and nitrous acid is again formed. This in its turn acts upon more sulphurous vapour, and so on throughout the whole extent of the chamber, undergoing alternations of decomposition and reformation, converting all the sulphurous vapour into liquid acid — the nitrogen finally leaving the chamber, as it entered it, in the form of nitrous acid.

In lixiviating rough alkali, or black ash as it used to be called, the liquor is run of from the vats occasionally; when at this time a slight decomposition of water takes place, and a portion of the insoluble sulphuret of calcium is converted into a soluble hydro-sulphuret of lime. If the mass in the vat was kept constantly covered with hot water no change would take place. This result might be attained by having an arrangement for distributing hot water over the whole area of the bottom of the vats by means of a series of inverted troughs, causing hot water to pass upward through the mass and flow off from the surface.

When all the alkali is washed out, the liquor must be run off from the bottom and the residue, consisting of sulphuret of calcium and the remains of coal, should be dried as quickly as possible. This might be done by removing it at once to a furnace, or a better plan would be to have a small portable apparatus for heating and forcing air, which might easily be contrived, so that warm air might be forced through the mass while still in the vat. The arrangement for distributing the water at the bottom would afford the means of doing this.

When sulphuret of calcium is thoroughly dried it may be kept without change for any length of time.

In this state sulphuret of calcium would prove very valuable in agriculture.

When sulphuret of calcium is treated by heat and steam sulphuretted hydrogen is driven off. If heated steam and heated air are thrown upon sulphuretted hydrogen all the elements to form sulphuric acid will be present. Possibly sulphate of ammonia might be formed, but this would depend chiefly upon the circumstances of temperature and proportions.

However, if all the requisite conditions can be arrived at

and fully maintained, there is every probability that liquid sulphuric acid may be condensed when these mixed gases are driven into a flue or chamber at a sufficiently reduced temperature.

The letter of your correspondent, Mr. Smith, on the *Economy of Sulphur*, which appeared in Chemical News of the 2nd instant, has called forth these remarks, the result of considerable experience and subsequent protracted study, from

An Old Alkali Manufacturer.

Chemical Notices from Foreign Sources.

I. ORGANIC CHEMISTRY.

Action of prolonged Heat and Water on different Substances.—Mr. H. C. Sorby[1], an Englishman we believe, sends to the Academy of Sciences an account of some experiments he has made on the above subject. He put different substances and various solutions in glass tubes, sealed them hermetically, and then placed them in the boiler of a high pressure engine, and kept them there exposed to a temperature ranging from 145° to 150° C. for some months. Others he placed in an ordinary kitchen boiler, in which the temperature varied from 75° to 100° C. The first facts noticed are the decomposition of the glass tubes employed. Crown glass resisted the action best—better even than Bohemian—but it was sometimes acted on at but slightly elevated temperatures. English flint glass was easily decomposed by the prolonged action of water below 100°. A fragment of flint or Bohemian glass enclosed in a tube of crown glass with a *little* water was more quickly decomposed than with much water. A moderately strong solution of nitric acid had little or no action on flint glass at 145° or 150°, while pure water soon changed it into a white crystalline mass. Wood exposed to a temperature of 145° without water underwent but little change, while some with water became quite black. A brilliant black substance separated from the wood, but the water remained quite clear although it had an acid reaction, due no doubt to acetic acid, and when the tube was opened a good deal of gas escaped. Some of the results obtained illustrate the pseudomorphosis of minerals, and of these experiments we hope the author will soon publish a fuller account.

Action of Chlorine on Valeric Aldehyde.—Kündig has been engaged in an investigation on this subject.[2] He finds that when a current of chlorine is passed into valeral the temperature at first rises a good deal, but afterwards it is necessary to apply heat to finish the reaction. The liquid obtained begins to boil at 100° C., giving off vapours of hydrochloric acid, but the thermometer is never stationary, continuing to rise until it reaches 190°, when only a carbonaceous mass remains. The same things happen on a second distillation. The boiling point of the principal product, however, appears to be somewhere about 147°. Kündig separated the liquids passing from 100° to 140°. Those which passed between 140° and 148°, and what passed at a higher temperature, washed with cold water and then treated with hot water and boiling alkalies, the various products gave neither valerianic nor hydrochldric acid. They do not contain then chloride of valeryle. With bisulphite of soda they form crystalline precipitates, the part passing between 140° and 148° becoming a mass. These crystals washed with water and then with alcohol gave on analysis numbers which led to the formula,

$$\left.\begin{matrix} C_5H_7Cl_2\Theta \\ H \end{matrix}\right\} + \left.\begin{matrix} (S\Theta_2)'' \\ NaH \end{matrix}\right\} \Theta$$

Nor is chloride of valeryle produced when valeral is acted on by chlorine in sunlight: but if the chlorine has been in excess, the crystalline compound with bisulphite of soda is not obtained.

M. Cahours obtained by the action of chlorine on amylic alcohol, a body which he named chloramyl, and for which Gerhardt proposed the formula $C_5H_9Cl_2\Theta$. This formula Kündig says appears to me the true one; for having repeated the experiment of Cahours, and treated the product with bisulphite of soda, he obtained a crystalline compound containing a good deal of chlorine.

Alcoholic Fermentation.—Some experiments of Lunge confirm the statement of Berthelot that fermentation may go on without the production of vegetable cells. Lunge repeated the experiment with mannite, gelatine water and carbonate of lime, and found an appreciable quantity of alcohol produced, and the liquid full of infusoria of the genus *Bacterium*, but the most careful examination with the microscope revealed no vegetable cells.

II. ANALYTICAL CHEMISTRY.

Volumetric Method of estimating Copper.—Mohr's method of estimating copper by adding a standard solution of cyanide of potasium to an ammoniacal solution of the copper, Herr Fleck[3] says offers two objections: the quantity of cyanide necessary to destroy the blue colour varies according to the quantity of ammonia the liquid contains, and at the end of the operation it is difficult to tell the exact moment at which the blue colour disappears. To remedy these inconveniences the author proposes to dissolve the copper compound in *carbonate of ammonia* instead of ammonia. He shows that an excess of this salt does not interfere with the reaction. In the second place he adds a drop of prussiate of potash to the blue liquor, and then at the moment the cupro-ammoniacal compound is destroyed the liquid becomes red.

Indigo Test for Glucose.—Glucose and grape sugar transform blue indigo into white in the presence of alkalies. Mulder[4] on this reaction founds a process for the detection of small quantities of these sugars. He adds to the liquid to be tested sulphate of indigo, to which an excess of carbonate of potash or soda has previously been added. The addition of the alkaline salt scarcely affects the blue colour of the indigo solution even after boiling, and the presence of the alkali is necessary for the reduction of the indigo to take place. If the liquid contains glucose or grape sugar the blue colour disappears at the ordinary temperature, and more quickly if it be heated. Cane sugar boiled with the blue liquor produces no change.

Gun Cotton as a Filter for strong Acids.—Böttger[5] recommends chemists to use gun cotton as a filter for concentrated acids and liquids decomposable by organic matters. The author employs it with the greatest advantage for filtering concentrated nitric acid, fuming sulphuric acid, chromic acid, permanganate of potash, and even concentrated solutions of potash and aqua regia. He says that properly prepared gun cotton is only attacked at the ordinary temperature by acetic ether.

Estimation of Sugar in Urine.—Some time ago Brücke published the following process for detecting sugar in urine. Fresh urine is first treated with a concentrated solution of neutral acetate of lead and filtered. The filtered liquid is then precipitated with subacetate of lead and again filtered. Ammonia is now added to the filtered liquor and the presence of sugar in the precipitate so obtained is proved by the ordinary tests. The author now[6] points out that the precipitate occasioned by the subacetate of lead always contains a small quantity of sugar, and therefore this reagent ought not to be employed when a quantitative estimation of the sugar is made. The subacetate of lead, the author states, gives no precipitate with a solution of pure glucose, but when glucose is added to normal urine containing only a trace of sugar, the precipitate obtained with the subacetate always contains sugar. It would appear therefore the urine contains something which makes sugar precipitable by the

[1] *Comptes-Rendus*, t. l. 908.
[2] *Annal. der Chem. und Pharm.* Bd. cxiv. s. 2.
[3] *Polytech. Centralblatt*, 1859, p. 1313.
[4] *Arch. der Pharm.* Bd. cxiv. s. 268.
[5] *Annal. der Chem. und Pharm.*, Bd. xxxviii. s. 3.
[6] *Sitzungsb. der K. Akad. der Wissenschaf. zu Wien*, Bd. xxxix. s. 10.

subacetate. The author confirms the statement he made in his former paper, that healthy urine always contains small quantities of saccharine matter, and shows that this matter is fermentable.

III. TECHNICAL CHEMISTRY.

Cyanuration of Barium and formation of Ammonia from the Nitrogen of the Air.— After experiments conducted on a sufficiently large scale, MM. Margueritte and De Sourdeval [7] think themselves justified in concluding: 1, that baryta calcined with charcoal in the presence of air, easily assimilates both carbon and nitrogen, and that the cyanuration of barium until now unknown, is an operation of the greatest simplicity; 2, that the cyanide of barium is decomposed about 300° C. under the influence of a current of steam, and the whole of the nitrogen set free in the form of ammonia. The authors add that if they do not delude themselves, baryta will be found an agent able to fix so much nitrogen as to allow of the formation of various industrial products, such as ammonia, nitric acid, and the cyanides. They say farther, that by their process they obtain baryta in such a condition that the extraction of sugar from molasses by its means will become a really practicable operation. The authors' mode of proceeding is as follows. They calcine in an earthen retort and at a high temperature a mixture of carbonate of baryta, iron filings, coal tar and sawdust. By this means the greater part of the carbonate of baryta is deprived of its carbonic acid. A current of atmospheric air is now made to pass slowly through the porous mass, when the oxygen is converted into carbonic oxide, and the nitrogen forms cyanogen, and produces a considerable quantity of cyanide. If the object be to form ammonia the calcined mixture is placed in a cylinder, and a current of heated steam is passed through, whereupon all the nitrogen of the cyanide is disengaged in the form of ammonia.

LABORATORY MEMORANDA.

Detection of Oxygen in Hydrocarbons, &c.—Sir,—A few days ago I sent for a small quantity of fresh naphtha for refilling a bottle containing a considerable quantity of potassium. Not trusting the naphtha, I had the precaution of first throwing into it a small piece of potassium, pretty free from white oxide, when, to my surprise, the potassium instantly began to dissolve with a loud hissing noise and a great amount of heat, giving to the naphtha a dark brown colour very much like infusion of roasted coffee. Intending to make some use of the spoiled naphtha I refilled a large spirit lamp and presently set fire to it. It burnt with the usual purple flame peculiar to potassium, but in the course of ten minutes or so the lamp was extinguished. I lighted it again, and it was again extinguished in a much shorter time. On examining the lamp I found that some potash had collected on the top of the wick, as the naphtha had burnt away, forming a thick crust, whereby the further combustion of the naphtha became impossible. Of course from the fact that potassium had dissolved in the naphtha and become converted into potash I concluded that the naphtha must have contained some oxygen (perhaps in the shape of water). I sent for several other kinds of naphtha, and tried them in the same way; in some the potassium dissolved, in others not. From these results I judge that potassium must be a very reliable test for the presence of oxygen in hydrocarbons, either accidentally or by adulteration. Potassium produces no effect on oils and fats free of oxygen, and decomposes those which contain it. Now in the qualitative analysis of vegetable oils and juices potassium may be advantageously employed, and thus increase the practical value of this extraordinary element.

Thinking that these facts might perhaps please some of your readers, I deemed it right to send you these lines, which, if space permit, may perhaps serve for filling up a corner of the Chemical News.—*Dr. E. Unger.*

[7] *Comptes-Rendus*, t. l. 1100.

MISCELLANEOUS.

Rotten-Stone.—This is a useful yellow-coloured substance much employed in scouring brass and tin by mixture with a little sweet oil, then finishing off with some dry whiting. Very few persons know where it comes from, or of what it is composed. According to Professor Johnstone, it is composed of silica, alumina and carbon. It is obtained from a ridge in Derbyshire, England, which is covered with drift 10 or 20 feet thick, consisting of brown clay, with manes of black marble, chert, and rotten stone. The rotten-stone is so soft whilst in the soil that the spade goes through it readily, but it hardens on exposure. The holes from which it is dug are only two feet deep in some places; at others, from six to eight. On examining a series of specimens, Professor Johnstone found that while some were homogeneous others had a nucleus of black marble. He then treated specimens of the black marble with weak acid, and found that on the removal of the carbonate of lime, there remained from 15 to 20 per cent. of a silicious substance perfectly like the natural rotten-stone. He concluded that there existed in the soil some acid which penetrated it and dissolved out the calcareous matter of the rocks below. The agent in this case might be the carbonic acid of the air, brought down by rain; but there were instances not capable of explanation by this agency alone, and attributable to other acids, which are produced under certain conditions, and exercise a much wider influence. The bottoms of peat bogs present very strong evidence of the action of acids; the stone and clay are bleached and corroded, only silicious and colourless materials being left. The source of the acid is here the same as in the former instance; the vegetable matter growing on the surface produces in its decay substances which exert a chemical action on the subsoil, and escape by subterranean outlets, carrying away the materials dissolved in their progress. Another instance was afforded by the mineral Pigotite, formed in the caves of Cornwall by water dripping from the roof. This water contains a peculiar organic acid, derived from the soil of the moors, which dissolves the alumina of the granite and combines with it. The organic acids are very numerous and different in composition, but agree in producing chemical action upon rocks. They are produced over the entire surface of the earth, especially over uncultivated tracts, and are the means provided by nature to dissolve the mineral food of plants; they are also amongst the chief causes of the exhaustion of soils. In the green sandstone strata of Surrey, England, known as "firestone," the rock is light and porous, and contains silica in a soluble state. Common sandstone quartz or rock crystal is not acted upon by potash or soda at ordinary temperatures, but 30 per cent. and sometimes 70 per cent. of the silica in "firestone" may be dissolved. In all such cases the silica must have been originally in a state of chemical combination with lime, alumina, or something else, which has been subsequently removed. The silica in the rotten-stone was soluble, but black marble, in a bedded state, never was found converted into rotten-stone.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Seiwad.—Sea water contains in 1000 parts in round numbers 27 parts chloride of sodium, 5 parts chloride of magnesium, 5 parts sulphate of magnesia with very small proportions of chloride of potassium, bromide of magnesium and sulphate of lime, and 960 parts of water.

G.H.F.—The following are considered the best freezing mixtures:—Sal-ammoniac, nitre, common salt, of each 5 parts, water 16 parts. Nitrate of ammonia and water equal parts. When either of the above are dissolved in the stated quantities of water a considerable reduction of temperature ensues; depending in some measure on the original temperature of the water and salts employed.

Omicron.—The first were sold immediately. A second lot of Reading covers are now being made, and may be obtained on application at our Office.

J. Ellis.—W. D.—Medicus.—In our next.

Vol. I. of the Chemical News, containing a copious Index, is now ready, price 8s. 6d. handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. if sent to our office, or, if accompanied by a cloth case, for 6d.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London, E. C.

THE CHEMICAL NEWS.

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PROPOSED FORMATION OF AN ANTI-ADULTERATION LEAGUE.

THE Adulteration of Food and Drink Bill is moving very tardily through the Upper House, and at every step forward the time when it will become one of the laws of the land seems more and more distant. Everyone readily admits that legislation on the subject is imperatively necessary, and at the first glance welcomes the bill which is to usher in a new order of things, and clear us — *malgré nous* — from the reproach of being a nation of adulterators as well as of shopkeepers: but a second perusal of the proposed remedy brings to light grave defects, and in the desire to alleviate these, and at the same time not to infringe too much upon the liberty of the subject, careful committees of both houses have so pruned and emasculated it as to leave very little hopes of the reasonable expectations of its originators being answered when the bill does pass. Meanwhile, and doubtless to this is in some degree to be attributed the sluggish progress it is making, criticisms on the various clauses, with suggestions for their amendment, are being indulged in pretty freely, not only by that section of the press which like ourselves may be supposed to take particular interest in such technical details, but by the portion which appeals to the million. The last number of the *Cornhill Magazine*, for instance, contains an exceedingly clever article on this subject, in which the writer enlarges upon the universality of the practice, and the great evils which it entails upon the health of the community, the public morality, and the high commercial character of the country.

Under the simile of an insidious and mischievous demon, the monster evil of Adulteration is traced through the protean forms and shapes in which it is ever present before us, now tempting us through the eye, making things poisonous and deadly look attractive and inviting; at other times tempting us through the palate, by adding grains of paradise to gin, or coculus indicus to beer.

The definition of the term Adulteration is given in very plain and unmistakeable language. "The intentional addition to an article, for purposes of gain or deception, of any substance or substances, the presence of which is not acknowledged in the name under which the article is sold."

The permissive character of the Bill is considered a great obstacle to its intentions being properly carried out; in fact in discussing this clause, the writer in the *Cornhill Magazine* agrees almost literally with our own remarks on the same point, when first noticing the Bill (CHEMICAL NEWS, Vol. I. p. 122). The absurd restriction in the clause which renders it necessary that in the case of the sale of adulterated articles *knowledge of the fact* on the part of the seller must be proved, is also considered wholly unnecessary, and some other clauses are shown to actually afford a legal sanction to the perpetration of adulteration.

Other shortcomings are next pointed out, and their effects upon the practical working of the Bill discussed, and then the writer proceeds to the subject of punishment and prevention. These, with the exception of the punishment for second offences (publication of the name and address), are considered wholly inadequate. "Such treatment will hardly scotch the monster Adulteration, much less kill him: he will still be caught from time to time at his old tricks. There is nothing in fact to prevent him from still colouring our cayenne with red lead, adding coculus indicus to beer, destroying the coats of the drinker's stomach by doses of a mixture of cayenne, or grains of paradise and gin, and poisoning our children through the sweets made so attractive in order to tempt them; nay, he will still destroy the last hope of the physician, by deteriorating the drugs upon which he relies for the salvation of life."

This is a blank prospect, and were there nothing but what we have already touched upon in the article, it would have scarcely been worth bringing so prominently before our readers, our own remarks in former numbers having pretty fully discussed the failings of the Bill. There is, however, a valuable suggestion thrown out, to which we beg our readers' serious attention, as we intend presently to lay before them a modification which is capable of instant adoption, and which will, in fact, place at once in everybody's possession almost all the advantages anticipated from the Bill before Parliament, without any of the concomitant evils. The suggestion referred to is contained in the following paragraph:—

"'Put not your faith in princes;' to which we may add nor in Parliaments either, especially in any case in which people can help themselves. In the matter of adulteration the public can do much to protect itself, by requiring with all purchases of articles of food or drink the guarantee to which we have adverted; but there is a second means of affording great additional protection, and that is an organisation originating with and supported by consumers. It should consist of members paying a small annual fee, and have for its object the analysation free of any further charge of such articles as are forwarded for analysis by the members. Periodical reports should be issued under the sanction of a committee of management giving the results, whatever these might be, of the examination of the various articles. Such an organisation as this would do immense good."

Of this we are perfectly convinced; and being anxious to see some stop put to this monstrous and growing evil, we are induced to propose a similar organisation at once to our readers.

The universal opinion seems to be that when real work

is to be done the fewer masters there are, and the less fettered the workers are, the more satisfactory will be the results to those who are interested in them. For the purposes of dedecting adulteration by an analytical association, the simpler the organisation the better. Now it so happens that in the management of this Journal just such an organisation exists as is wanted. There is an editorial staff of skilled analysts well experienced in the detection of all kinds of adulteration, and in connection with these a well-appointed laboratory. Again, there is a weekly journal upon which the public have pronounced higher praise than it would befit us here to give it, by buying it in large numbers; this would naturally be the receptacle for all that was novel or interesting in the researches of the Adulteration Committee; and lastly, there is the name of the editor, published on every number of the journal issued. We are thus directly answerable in our reputation for the accuracy of any analysis or report performed by any member of the editorial staff. Here, then, is responsibility enough to satisfy any one.

We therefore propose to inaugurate an "Anti-Adulteration League," the members of which will pay a small subscription per annum, and will during that time have the privilege of sending to us suspected articles of food or drink to be examined and reported upon free of extra charge, in respect to any real or supposed adulteration which they may contain; the results of such examinations to be published weekly in the Chemical News, together with such comments as the nature of the case would seem to render necessary. We shall of course expect that all reasonable assistance and information be given when any suspected article of food is sent, such as the names and addresses of the purchaser and vendor, and where it is practicable the nature of the adulteration which it is suspected to contain, for it must be remembered that our object will not be to guess riddles or to show our analytical acumen by finding out chemical puzzles, but merely to render useful and practical information on a definite subject, and we are therefore entitled to all the assistance which it is in the power of members to give. We do not ask for the names and addresses in order to make them public, in fact we hardly think such a course would be advisable, but merely for our own information and as a guarantee of good faith on the part of the sender. It may also be necessary to limit in some degree the number of examinations which each subscriber is entitled to have performed during the year, for it would be unreasonable to expect that the payment of a small annual sum would entitle any person to ask us to perform an unlimited number of analyses, each of which would in the ordinary course of business be worth more than the year's subscription.

Such are the chief points which appear to us necessary to be mentioned in this preliminary notice. We must now leave the matter in the hands of our readers; if the scheme seems to meet with reasonable approbation and support we shall be prepared to enter into it with that energy which so important a subject deserves. If, on the other hand, we meet with but little encouragement to proceed the matter will fall to the ground, and we shall be led to imagine that the national horror of adulteration is not so great as the members of the third and fourth estates would have us believe is the case.

Meantime we shall be obliged if any reader who may feel inclined to favour us with suggestions or promises of support will communicate with us by letter to Mr. Crookes at our Office 12 Red Lion Court, Fleet Street.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Alcoholic Fermentation, by M. L. Pasteur.[1]

By the term alcoholic fermentation is understood that change which sugar undergoes under the influence of yeast, and which produces wine and all other alcoholic drinks. It serves as the type of a number of other analogous phenomena, known by the generic term fermentation, but specially designated by the name of the essential product of the particular phenomenon, as the panary, the lactic, the acetic fermentation, &c. Under the term alcoholic we do not include all the phenomena of fermentation in which alcohol is produced, for many kinds have that common character; but the words are used in the sense in which they have been applied by Lavoisier, Gay-Lussac, Thenard, and others, viz. to designate the fermentation of sugar with yeast. Our present knowledge of the products of the transformation of sugar in the alcoholic fermentation may be summed up in the two following propositions:—

1. Cane sugar, $C_{12}H_{11}O_{11}$, after being modified into grape sugar, $C_{12}H_{12}O_{12}$, ferments, and splits up into alcohol and carbonic acid. The sum of the weights of the alcohol and carbonic acid represents very nearly the weight of the sugar.

2. A very small proportion of the sugar is changed isomerically into lactic acid of the same composition as the sugar.

In the course of this essay it will be shown that the first proposition is never exact, being really only a rough approximation to the truth; and that the second is altogether erroneous as far as regards the nature of the acid, which is in no case lactic, unless the alcoholic fermentation is accidentally complicated with another—the lactic fermentation.

The results presented in the following memoir have been arrived at in the course of investigations which have occupied the author without interruption for three years.

1. *Glycerine and Succinic Acid are Products of the Alcoholic Fermentation. Their Separation and Estimation.*

Many methods may be used to prove the formation of succinic acid in the alcoholic fermentation. One of the simplest is to evaporate the fermented liquid after having filtered it to separate the yeast, and then to treat the residue several times with ether, which is afterwards allowed to evaporate spontaneously. In the course of a day or two the sides of the glass are seen to be covered with crystals of succinic acid. At the bottom is a syrupy liquid full of the same crystals: this consists almost entirely of glycerine saturated with succinic acid. This process is not admissible for extracting and estimating succinic acid, but will serve to prove its presence in all fermented liquids, whatever may be their nature and origin.

Glycerine may be detected almost in the same way, but in place of ether it is better to exhaust the residue with a mixture of alcohol and ether. This mixture dissolves the succinic acid and glycerine, and leaves behind the nitrogenised extractive matters. The ethereal and alcoholic solution is concentrated, saturated with lime, and then evaporated to dryness: the residue is again treated with the mixture of alcohol and ether, which now only dissolves the glycerine and leaves the succinate of lime.

When, however, it is wished to completely isolate the

[1] Abridged from the *Annal. de Chim. et de Phys.* t. l. viii. p. 323.

succinic acid and glycerine and determine them quantitatively, it is necessary to adopt particular precautions. The principal difficulty in the analysis of a fermented liquid proceeds from the soluble products which the yeast supplies, or which result from its transformations. The nature of these products is always the same, but their proportion varies with the quantities of yeast and sugar employed.

When yeast is mixed with a solution of sugar it gives up to that liquid a part of the soluble principles confined in the interior of its globules. Some saline matters, principally phosphates, and some nitrogenous albumenoid matters are dissolved, and the globules deriving part of their nourishment from these two sorts of substances, live, bud and multiply. These mutations give rise to modifications of the original products, or to new bodies, some solid and insoluble, others liquid and soluble, which remain in the liquid, and are found therein when the fermentation is finished mixed with the products of the decomposition of the sugar. With these general considerations before us we proceed to the separation and estimation of some of the products of the fermentation.

The weight of the yeast employed must first be carefully determined, and an equal weight of the same yeast must be dried at 212° and then weighed, so that the amount of dry matter which the yeast contains may be known.

When, on attentively examining a fermenting liquid for some minutes, no bubbles of gas are seen to rise, we may conclude that the fermentation is finished, unless the alcoholic is complicated with the lactic fermentation, in which case the disengagement of gas may cease while a good deal of sugar remains undecomposed. But this is an exceptional case which only occurs when the yeast employed is stale and contains some of the lactic ferment. To be quite certain a small quantity of the liquor may be tried with Fehling's solution.[2]

The fermented liquor is now filtered through a filter tared with another of the same paper. After drying at 212° one weighing will give the weight in the dry state of the yeast deposited in the course of the fermentation. The filtered liquid is then very slowly evaporated to a small bulk and the evaporation is finished in a vacuum. After twenty-four hours the syrupy residue is treated seven or eight times with a mixture of one part of alcohol and one and a half parts of ether. Each washing should be filtered, although generally the insoluble matter remains as a plastic mass at the bottom of the capsule. To determine the amount of this insoluble matter it is only necessary to redissolve it in water, evaporate it in a water bath in a weighed capsule, and dry in a stove at 212° until the weight is constant. Its composition will be examined hereafter.

The flask containing the alcoholic-ethereal solution is placed in warm water to drive off the greater part of the ether, the evaporation is then continued at a very gentle heat, and finished as before in vacuo. Pure and perfectly clear lime-water is then added, to exactly neutralise the acid, the evaporation is repeated with the same precautions, and the residue again treated with the mixture of alcohol and ether, to dissolve the glycerine. The succinate of lime remains behind in a crystalline state, contaminated with a small quantity of extractive matter or lime-salt of an uncrystallisable acid. These impurities may be removed by digesting the succinate of lime for twenty-four hours with alcohol, which dissolves the foreign matters and leaves the succinate sufficiently pure. It may then be collected on a tared filter, dried and weighed.

The glycerine may be weighed after having evaporated the alcoholic solution at a gentle heat, the evaporation being completed under the air pump, where however it must not remain longer than two or three days, as it continues to lose weight after having been deprived of water. In this way all the glycerine is obtained without loss, and it may be regarded as pure when the liquid has been fermented under the influence of a sufficient but not unnecessarily large quantity of yeast. When much more yeast than is necessary has been used the glycerine will have a bitter taste, because yeast contains a very small quantity of matters which are soluble in the mixture of alcohol and ether.[3] Fermentation by itself gives nothing which can render the glycerine impure when extracted as above.

100 grammes of sugar-candy fermented with 1·198 grammes of dry yeast gave after the fermentation—

Succinic acid	0·673
Glycerine	3·640
Total	4·313

That the elements of the glycerine are furnished by the sugar, and that the yeast contributes nothing to it is proved by a comparison of the weights of the glycerine and yeast in the preceding experiment. Only 1·198 grammes of yeast were used, and the glycerine obtained weighed 3·64 grammes. But in this case it is not so clear with regard to the succinic acid. It is possible, however, by a particular experiment, to obtain an amount of succinic acid larger than the soluble matter of the yeast employed. The succinic acid therefore is formed from the sugar as well as the glycerine, and the elements of the yeast take no part in the formation of either of these products.

Glycerine, Succinic Acid, Alcohol and Carbonic Acid are not the only Products of the Alcoholic Fermentation.

In the preceding experiment, with 100 grammes of sugar the weight of the matters estimated after the fermentation, were as follows:

Yeast—deposited after the fermentation	1·700
Extract insoluble in alcohol and ether	0·631
Matter contaminating the succinate of lime	0·500
Total	2·831

If the original weight of the yeast, 1·198 grammes, be subtracted, there remain after the fermentation 1·633 grammes in excess of the weight of the yeast and its soluble matters, 100 grammes of sugar therefore have given one and a half gramme to the yeast. We shall see hereafter that cellulose of the new yeast globules constitutes the greater part of this excess, but whatever it may be, we see that the yeast takes something from the sugar, and if to this we add the weight of the glycerine and succinic acid, we have—

Glycerine	3·640
Succinic acid	0·673
Cellulose and undetermined matters	1·633
Total	5·946

We have not yet finished with the study of the transformations which sugar undergoes inconsistent with the theoretical equation $C_{12}H_{12}O_{12}=4CO_2+2C_4H_6O_2$, but shall continue them in another and very interesting direction.

(To be continued.)

[2] In ordinary cases, with a weak solution of sugar, the fermentation is finished in from fifteen days to three weeks, but when an excess of sugar and but little yeast are employed it may last for months or even years.

[3] The yeast has been separated by filtration, but the author remarks that an extremely small quantity of these matters suffice to give the glycerine a bitter sharp taste.—Ed.

TECHNICAL CHEMISTRY.

On some points in the Chemistry of Sugar Refining, by William Wallace, *Ph.D. F.C.S. Glasgow.*

There are many varieties of sugar, of which the three most important kinds are cane sugar or *sucrose* ($C_{12}H_{11}O_{11}$), fruit sugar or *fructose* ($C_{12}H_{12}O_{12}$), and grape sugar or *glucose* ($C_{12}H_{14}O_{14}$). The two last varieties, indeed, are often confounded together, and many chemists consider them identical, but the generally received opinion now entertained is, that there is no such thing as grape sugar produced by the vital functions of plants, but that it is formed, under particular circumstances, from fruit sugar, by the assimilation of two equivalents of water. Indeed, all the other sugars seem to change readily into glucose; and even starch and lignine, as is well known, are easily converted into this substance by the action of acids. In all cases the change is owing simply to the absorption of the elements of water. Very weak acids, with the aid of heat, effect the conversion of cane sugar first into fruit and then into grape sugar; an elevated temperature alone, in presence of water, accomplishes the same transformations, but much less rapidly. The following experiments, made with a solution of pure sugar in distilled water, will illustrate the danger of keeping syrups at an elevated temperature for a lengthened period of time. In the first experiment a quantity of the syrup was heated in a sand bath until a large proportion of the sugar crystallised out; more water was then added, and the evaporation and solution repeated two or three times. A thick syrup was thus obtained, which refused to give any crystals when kept for weeks over oil of vitriol. Analysis gave fourteen parts of fruit to one of cane sugar. In the next experiment the syrup was kept in the "bastard loft" of a sugar-house (temperature about 100°) for several months, water being added from time to time. A thick, almost semi-solid syrup was thus obtained, which did not show the slightest appearance of crystals even under the microscope. At this time it contained only one part of cane to ten of fruit sugar. The syrup was left exposed in the same vessel for some time afterwards without undergoing any apparent change, when suddenly the whole was transformed into a soft solid mass, consisting of distinct but microscopic crystals of grape sugar. Weak acids give rise to the formation of grape sugar; but this change does not appear to begin until all the cane sugar has first been converted into fructose. Crystals of grape sugar have never been observed by the author in any of the ordinary products of the sugar house, even in the strongest and heaviest syrups. It is true that minute crystals generally appear in heavy syrups and molasses, when kept for some time, but these are seen, on examination by a low power of the microscope, to consist of cane sugar crystallised in the usual form. Fruit sugar does not crystallise at all, but forms, on evaporation, a tenacious semi-solid mass. Grape sugar crystallises readily enough, from a tolerably strong solution which has not been exposed to too high a temperature.

With regard to the natural distribution of the two varieties of sugar, it appears that all sweet vegetable juices which are alkaline or neutral contain cane sugar only, while those that are acid contain fruit sugar only. The two sugars have never been found mixed together in the juices of plants. It is, unfortunately, but too easy to change cane sugar into fruit or grape sugar, but the reverse process cannot be effected by artificial means.

Cane sugar crystallises readily in four-sided prisms with rhomboidal base, but the crystals have generally a cubical appearance, and sometimes, by truncation, they assume the aspect of six sided prisms. The crystals are always sharp in the edges and solid angles, even when produced from the most impure syrups. Cane sugar is distinguished from all other bodies by its intensely sweet taste, which is best observed when the sugar is in fine crystals, as the sensation of sweetness depends very much upon the rapidity of solution. We frequently hear one kind of sugar called sweeter than another, the specimens being equally pure, as if sugar could be anything but sugar; and it is a fact that many refiners refuse to purchase fine large grained muscovado, and prefer smaller crystals, inferior in point of purity, simply because the larger crystals dissolve less rapidly in the mouth, and thus appear less sweet. It appears almost incredible that such ignorance as this should exist in a country where the standard of general education is so high.

Cane sugar is devoid of odour and colour. It is highly soluble in water, which takes up, at the comparatively low temperature of 4.8°, about an equal weight. With increase of temperature the power of solution is very much augmented, and at the boiling point of the liquid the capacity of water for dissolving sugar is almost unlimited. At the degree of heat at which syrups are boiled down in the vacuum pan (150° to 160°), water does not by any means possess this power of unlimited solution.

Fruit sugar is uncrystallisable, but forms, when dried in vacuo, at the ordinary temperature of the air, a gummy semi-solid mass. It possesses a peculiar action upon polarised light, which distinguishes it from grape sugar, to which it is closely allied in many respects. The author has never found this variety of saccharine matter, as produced artificially, in a pure state, but always mixed with cane sugar. It exists abundantly in golden syrup, molasses, and treacle. Cane sugar refuses to crystallise from a syrup which contains rather more than an equal weight of this variety, and it has been found that a syrup which contains less than eight parts of cane to ten of fruit sugar is absolutely undrainable at any temperature.

Grape sugar, as already stated, never occurs in any of the products of the sugar manufacture. It crystallises in fibrous masses or tufts, radiating from a centre, presenting a very beautiful appearance when examined with a lens. The crystals are soft and minute, and no definite crystalline form has as yet been ascribed to them. Grape sugar is frequently called uncrystallisable sugar, but this is evidently a misnomer, arising from its being confounded with fructose. It has little economic value, its sweetening power being 2½ times less than that of cane sugar. Fruit sugar soon changes to grape sugar if no cane sugar is present. We frequently find tufts of this substance in raisins and other dried acid fruits, the skins of which have been ruptured. The whiteness and viscousness of old honey is owing to the presence of crystals of glucose. The author has seen jelly and other preserves, in which all the cane sugar introduced had been altered by heat and acid, become opaque and semi-solid from the same cause. This phenomenon must not be confounded with the much more common one of cane sugar forming a hard crisp crust upon the surface of the jelly.

The action of ferments, so far as these are concerned in the process of sugar refining, next claims our attention. This is a subject which presents many points of difficulty, yet it is too important to be wholly omitted in such a discourse as the present. If sugar-canes are cut during the rainy season, and allowed to lie over for a few days before the juice is expressed, no crystallised sugar can be obtained from them, only molasses, and even these of an inferior description. Again, if the char-washings of the

refinery are permitted to stand aside for a similar period of time before they are boiled down, the sugar which they contain is almost entirely destroyed. Occasionally the whole of the syrups in a sugar-house undergo a peculiar kind of fermentation, converting the syrups into a viscid condition, in which they refuse to drain away from the crystallised sugar. This condition is known technically as "smear," and its entrance into a sugar-house is considered analogous to the advent of a plague into a city, or of glanders into an extensive stable. The author has devoted considerable time to the study of this highly obscure subject, and thinks he has at last succeeded in assigning a cause, of which this smear is the probable result.

It is well known that sugar is liable to a variety of kinds of fermentation, depending upon the presence of certain substances in a state of change, the strength of the solution, its temperature, and other causes. Thus, when the solution is rather weak, and vegetable fibrine is present (as in grape juice), the yeast plant, the sporules of which are constantly floating in the atmosphere, readily vegetates, and the result is the breaking up of the sugar into alcohol and carbonic acid. Again, when the liquid contains caseine, as in milk, and the liquid is in a condition favourable to the putrefactive decomposition of this nitrogenous principle, the sugar is converted into lactic acid. When the temperature is high (90° to 110°) on the other hand, and some nitrogenous matter is also present, the sugar undergoes the viscous fermentation, in which a mucilaginous matter, mannite, and other substances, are formed. The viscous fermentation occurs with peculiar rapidity in the expressed juice of the beet and many other vegetables, and in the manufacture of rum in the West Indies it has to be kept in check by the addition of sulphuric acid. In the sugar-house we have many of the conditions fulfilled which are necessary for the development of the viscous fermentation, and although the mucilaginous matter is never formed in such quantity as to separate from the liquid, yet I have no doubt that this, or some other allied body with which we are yet unacquainted, is the cause of syrups becoming smeary. It occurred to me that the spread of this fermentation through the different floors of a sugar-house, from mould to mould, until all assumed the same aspect, might be connected with the vegetation of a microscopic plant resembling yeast, and that the alteration of a solution of pure sugar into fructose, and ultimately into glucose, as already noticed, might be owing to the same agency. On examining a specimen of smeary syrup with a microscopic power of 200 diameters, I found numerous protophytes, mostly of a green tint, but some brown. These consisted of single cells, enclosing frequently smaller cells; and some were seen burst at one side, with the smaller organisms making their escape. Ciliary motion was not perceived in any of these bodies, but probably the viscid nature of the liquid tended to check the exertion of the ciliary force generally observed in these protophytes at a particular stage of their existence. Several specimens of smeary syrup, and of grape and fruit sugar solutions formed in the manner already described, have since been examined, and in all cases abundance of these protophytes, mostly of the commoner sorts, have been found. The author does not presume to state that these plants are the true cause of the production of smear, but he thinks that this is by no means improbable. The occurrence of smear in a sugar-house is almost always the result of want of cleanliness, and nothing will produce it more rapidly than having dirty spars of wood in the char cisterns and elsewhere. In like manner, a piece of wood kept moist with water, and at a temperature of 60°, or upwards, soon acquires a "confervoid" odour from the growth of a similar class of plants in the water surrounding it. Again, sulphurous acid, which is well known to be inimical to vegetable life, is one of the few chemical agents which check the ravages of this fermentation, and this substance is now largely employed, generally in the form of bisulphite of lime, both in the beet sugar factories of France and Belgium, and in our own colonies. It is to be regretted that the sulphate of lime thus produced exercises a prejudicial influence upon the charcoal of sugar refineries. A sugar-house in which a tendency to smear begins to show itself should be at once fumigated with sulphurous acid, as the best means of checking the advance of fermentation, but there is little danger of this occurring where everything is clean and orderly, and the liquors are not kept too long. The old system of treacle pots is a very absurd one, and should in every case be discontinued, and the pots replaced by copper gutters.

It is but too well known to sugar refiners that molasses, apparently good, frequently give a perfectly undrainable mass when boiled down. This seems to depend in many cases simply upon the presence of an undue amount of fruit sugar, together with acid, by which the quantity of fruit sugar is greatly increased in the boiling. In other instances brought under the author's notice this explanation was inadmissible, and the undrainable nature of the resulting "bastards" must have been owing to the presence of the mucilaginous matter already referred to. Molasses, especially if very sour, should be passed through char before being boiled down.

The power possessed by sugar of combining with common salt and other saline substances, and the property of the salts of preventing the sugar from crystallising, are matters of which little is known by our refiners, but they constitute an evil of considerable magnitude to the beet sugar manufacturer. The beet sugar that is now imported largely into this country, and which is the third or fourth crop of crystals, always contains 1½ to 2½ per cent. of soluble salts, and in more than one sample as much as 4½ per cent. of nitrate of potash was found. When the sugar is refined alone, the salts accumulate in the syrup and communicate to it a distinct saline flavour, but the common custom is to use three parts of muscovado to one of beet.

The following table contains the average results of many analyses of several kinds of raw sugar, *as imported into Greenock and Glasgow*, and of the different products of a Greenock sugar-house:—

	West India.	Bast.	Date.	Lumps.	Floors.	Bastards.	Green Syrup.	Golden Syrup.	Molasses.	Treacle.
Cane Sugar .	94·4	95·7	95·4	97·3	87·7	68·3	62·7	39·0	48·0	32·5
Fruit Sugar .	2·2	·3	1·8	·5	6·0	15·0	8·0	33·0	18·0	37·2
Extractive and Col. Matter .	·3	·4	·1	—	·5	1·2	·6	2·8	1·5	3·5
Ash . . .	·2	1·6	·2	·2	·8	1·5	1·0	2·5	1·4	3·4
Insol. Matter .	·1	—	1·7	—	—	—	—	—	—	—
Water . .	2·8	2·0	0·8	2·0	5·0	14·0	27·7	22·7	31·1	23·4
	100	100	100	100	100	100	100	100	100	100

On the Titaniferous Iron Ores of Canada, by T. STERRY HUNT, *F.R.S.*

I HAVE read with much interest Mr. Mushet's paper on the titanic iron ores of New Zealand, in the CHEMICAL NEWS of April 21, as well as Mr. Stenson's note in that of the 12th of May. Should Mr. Mushet's conclusions be verified by experiments on a large scale, it will become very important to obtain a cheap and abundant

supply of the ores of titanium, which the officers of the Geological Survey of Canada have shown to exist in vast quantities in this country. At Bay St. Paul, on the St. Lawrence, sixty miles below Quebec, are several deposits of ilmenite, in a stratified feldspathic rock. One of these is a bed 300 feet long and 90 feet thick; several smaller masses occur near, and another still larger is said to exist in the vicinity. The ore is massive, and often coarsely granular; its specific gravity is from 4·56 to 4·66; according to my analysis it contains, titanic acid, 48·60; protoxide of iron, 37·06; peroxide of iron, 10·42; magnesia, 3·60 = 99·68. In some portions of the ore red grains of rutile are abundantly disseminated. These deposits occur in the rocks of the Laurentian series, which contain smaller quantities of the ore in many other localities.

Among the altered rocks of the Silurian series in Eastern Canada titanium is very abundantly distributed; in Sutton and Brome great beds of schistose specular iron, more or less titaniferous, are met with, and at St. François (Beauce), about sixty miles south of Quebec, there occurs, in serpentine, a bed, forty-five feet thick, of an ore consisting of a mixture, separable by the magnet, of about two parts of magnetic oxide and one part of titaniferous iron ore, similar in composition to that of Bay St. Paul. These deposits, and especially that of Bay St. Paul, will furnish inexhaustible supplies of titaniferous ores. Should these be required for mixing with other ores of iron, of which the pure magnetic and specular species also abound in Canada, and are now the object of a large exportation to the United States, where they are smelted with the poorer ores of the coal formation in that country. The titaniferous ores of Canada are described with analyses in the reports of the Geological Survey for 1847 and 1849. Masses of several hundred pounds weight, procured by myself from Bay St. Paul, were shown at the London Exhibition in 1851, and at that of Paris in 1855. Similar specimens will also be found in the Crystal Palace at Sydenham, in the collection of Canadian minerals, placed there in 1856, and in the Ecole des Mines, in Paris.

In 1855 the late Adrian Chenot, metallurgist, of Paris, informed me that he had obtained alloys of chromium and titanium with iron, which possessed very remarkable properties. They were prepared, according to him, from metallic sponges, obtained by reducing, by the aid of carbonic oxide, mixtures of chromic and titanic iron with pure iron ores, being a modification of his patented metallurgical processes for the manufacture of iron and steel. I at that time placed a considerable quantity of the titaniferous ore of Bay St. Paul in the hands of Mr. Chenot for experiment, but his unfortunate and premature death soon after prevented the completion of his experiments.

Montreal, Canada, June 7, 1860.

PHARMACY, TOXICOLOGY, &c.

Notes on some of the Drugs of the Levant.

(From a Correspondent of the Chemical News.)

Madder.—Asia Minor, at the present time, produces annually about 60,000 sacks of madder roots, the average weight of which is usually two and a half cwts. each. The principal districts of production are Bakir, Cayagik, Demirgik, Yordes, Caramania, and Allazata. A small quantity also is grown in Syria and in the islands of Imbros and Cyprus. The qualities most esteemed are the Bakir madder roots. These are generally of a bolder and brighter colour than the others. Those of Allazata and Cayagik are also of excellent quality. Syrian and Cyprus are the most inferior kinds. But wherever they are grown in Turkey the roots are forwarded to Smyrna, where they are garbled and packed by means of hydraulic presses into bales, which weigh from six to seven cwts. each.

The crop this year is estimated at about 50,000 sacks, but the quantity is in some measure regulated by the prices. When the prices are low the growers refuse to dig up the roots, and high prices will sometimes encourage them to dig when the roots are only two years old. It is however most advisable to allow them to remain in the ground from three to four years, according to the sort. The present value of Bakir roots in Smyrna is 46*s.* 6*d.* per cwt. and of other kinds from 39*s.* to 45*s.* 6*d.* per cwt.

Persian Berries. — The yellow berries, usually termed Persian berries, are grown in Cæsarea; the cultivation, however, is now nearly abandoned, and in a few years the article will probably disappear from commerce. The present price of 38*s.* to 44*s.* per cwt. hardly covers the expense of carriage from Cæsarea, and the heavy duties and tithes, which, although supposed to be *ad valorem*, are levied upon the old price of 7*l.* to 8*l.* Some years ago well grown Persian berries were worth 28*l.* per cwt. The quantity still brought to the Smyrna market is about 1500 sacks annually. The berries are now collected by the peasants on account of the landed proprietors they receiving in payment one half the quantity.

Opium.—This narcotic is now being collected. The crop this year is unusually large, and is expected to reach 3600 baskets, of about 140 lbs. each, the average production being 2500 baskets. No price has yet been fixed, but it is expected that 18*s.* per lb. will be about the figure at the commencement of the season. The average consumption of different countries is as follows:—

England	400 baskets.
America	900 „
China	1000 „
Java	500 „
Borneo	100 „
France	80 „
Germany	60 „

The above figures, however, vary considerably according to price, particularly with regard to the exports to China.

Smyrna, June 1860.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The inaugural address of the President, Lord Wrottesley, was delivered on Wednesday last. It contained the usual *resumé* of scientific discoveries in the past year, from which we extract the part relating to chemistry:—

"In chemistry I am informed that great activity has been displayed, especially in the organic department of the science. For several years past processes of substitution (or displacement of one element or organic group by another element or group more or less analogous) have been the main agents employed in investigation, and the results to which they have led have been truly wonderful; enabling the chemist to group together separate compounds of comparatively simple constitution into others much more complex, and thus to imitate, up to a certain point, the phenomena

which take place within the growing plant or animal. It is not indeed to be anticipated that the chemist should ever be able to produce by the operations of the laboratory the arrangement of the elements in the forms of the vegetable cell or the animal fibre; but he may hope to succeed in preparing some of the complex results of secretion or of chemical changes produced within the living organism, — changes, which furnish definite crystallisable compounds, such as the formiates and the acetates, and which he has actually obtained by operations independent of the plant or the animal.

"Hofmann, in pursuing the chemical investigation of the remarkable compound which he has termed *triethylphosphine*, has obtained some very singular compound ammonias. Triethylphosphine is a body which takes fire spontaneously when its vapour is mixed with oxygen, at a temperature a little above that of the body. It may be regarded as ammonia in which an atom of phosphorus has taken the place of nitrogen, and in which the place of each of the three atoms of hydrogen in ammonia is supplied by ethyl, the peculiar hydrocarbon of ordinary alcohol. From this singular base Hofmann has succeeded in procuring other coupled bases, which though they do not correspond to any of the natural alkalies of the vegetable kingdom, such as morphia, quinia, or strychnia, yet throw some light upon the mode in which complex bodies more or less resembling them have been formed.

"The power which nitrogen possesses of forming a connecting link between the groups of substances of comparatively simple constitution, has been remarkably exemplified by the discovery of a new class of amide acids by Griess, in which he has pointed out a new method, which admits of very general application, of producing complex bodies related to the group of acids, in some measure analogous to the poly-ammonias of Hofmann.

"Turning to the practical applications of chemistry, we may refer to the beautiful dyes now extracted from aniline, an organic base formerly obtained as a chemical curiosity from the products of the distillation of coal-tar, but now manufactured by the hundredweight in consequence of the extensive demand for the beautiful colours known as Mauve, Magenta, and Solferino, which are prepared by the action of oxidising agents, such as bichromate of potash, corrosive sublimate, and iodide of mercury upon aniline.

"Nor has the inorganic department of chemistry been deprived of its due share of important advances. Schönbein has continued his investigations upon ozone, and has added many new facts to our knowledge of this interesting substance; and Andrews and Tait, by their elaborate investigations, have shown that ozone, whether admitted to be an allotropic modification of oxygen or not, is certainly much more dense than oxygen in its ordinary condition.

"In metallurgy we may point to the investigations of Deville upon the platinum group of metals, which are especially worthy of remark on account of the practical manner in which he has turned to account the resources of the oxy-hydrogen blowpipe, as an agent which must soon be very generally adopted for the finer description of metallurgic operations at high temperatures. By using lime as the material of his crucibles and as the support for the metals upon which he is operating, several very important practical advantages have been obtained. The material is sufficiently infusible to resist the intense heat employed; it is a sufficiently bad conductor of heat to economise very perfectly the high temperature which is generated; and it may be had sufficiently free from foreign admixture to prevent it from contaminating the metals upon which the operator is employed."

After some remarks on recent discoveries in geology and palæontology the noble Lord concluded as follows:—

"In the recent progress of physiology I am informed that the feature perhaps most deserving of note on this occasion is the more extended and successful application of chemistry, physics, and the other collateral sciences to the study of the animal and vegetable economy. In proof I refer to the great and steady advances which have, within the last few years, been made in the chemical history of nutrition, the statics and dynamics of the blood, the investigation of the physical phenomena of the senses, and the electricity of nerves and muscles. Even the velocity of the nerve force itself has been submitted to measurement. Moreover, when it is now desired to apply the resources of geometry or analysis to the elucidation of the phenomena of life, or to obtain a mathematical expression of a physiological law, the first care of the investigator is to acquire precise experimental data on which to proceed, instead of setting out with vague assumptions and ending with a parade of misdirected skill, such as brought discredit on the school of the mathematical physicians of the Newtonian period.

"But I cannot take leave of this department of knowledge without likewise alluding to the progress made in scrutinising the animal and vegetable structure by means of the microscope, more particularly the intimate organisation of the brain, spinal cord, and organs of the senses; also to the extension, through means of well directed experiment, of our knowledge of the functions of the nervous system, the course followed by sensorial impressions and motorial excitement in the spinal cord, and the influence exerted by or through the nervous centres on the movements of the heart, bloodvessels, and viscera, and on the activity of the secreting organs—subjects of inquiry which, it may be observed, are closely related to the question of the organic mechanism whereby our corporeal frame is influenced by various mental conditions.

"And now, in conclusion, I may perhaps be permitted to express the hope that the examples I have given of some of the researches and discoveries which occupy the attention of the cultivators of science, may have tended to illustrate the sublime nature, engrossing interest, and paramount utility of such pursuits, from which their beneficial influence in promoting the intellectual progress and the happiness and well-being of mankind may well be inferred. But let us assume that to any of the classical writers of antiquity, sacred or profane, a sudden revelation had been made of all the wonders involved in creation accessible to man; that to them had been disclosed not only what we now know, but what we are to know hereafter, in some future age of improved knowledge; would they not have delighted to celebrate the marvels of the Creator's power? They would have described the secret forces by which the wandering orbs of light are retained in their destined paths; the boundless extent of the celestial spaces in which worlds on worlds are heaped; the wonderful mechanism by which light and heat are conveyed through distances which to mortal minds seem quite unfathomable; the mysterious agency of electricity, destined at one time to awaken men's minds to an awful sense of a present Providence, but in aftertimes to become a patient minister of man's will, and convey his thoughts with the speed of light across the inhabited globe; the beauties and prodigies of contrivance which the animal and vegetable world display, from mankind downwards to the lowest zoophyte, from the stately oak of the primeval forest to the humblest plant which the microscope unfolds to view; the history of every stone on the mountain brow, of every gay-coloured insect which flutters in the sunbeam—all would have been described, and all which the discoveries of our more fortunate posterity will in due time disclose, and in language such as none but they could command. It is reserved for future ages to sing such a glorious hymn to the Creator's praise. But is there not enough now seen and heard to make indifference to the wonders around us a deep reproach, nay, almost a crime? If we have neither leisure nor inclination to track the course of the planet and comet through boundless space, to follow the wanderings of the subtle fluid in the galvanic coil or the nicely poised magnet, to read the world's history written on her ancient rocks, the sepulchres of stony relics of ages long gone past, to analyse with curious eye the wonderful combinations of the primi-

tive elements and the secret mysteries of form and being in animal and plant, discovering everywhere connecting links and startling analogies and proofs of adaptation of means to ends—all tending to charm the senses, to teach, to reclaim a being, who seems but a creeping worm in the presence of this great creation. What, I repeat, if we will not or cannot do these things, or any of these things, is that any reason why these speaking marvels should be to us almost as though they were not? *Marvels* indeed they are, but they are also mysteries, the unravelling of some of which tasks to the utmost the highest order of human intelligence. Let us ever apply ourselves seriously to the task, feeling assured that the more we thus exercise, and by exercising improve our intellectual faculties, the more worthy shall we be, the better shall we be fitted to come nearer to our God."

ROYAL INSTITUTION OF GREAT BRITAIN.

On recent Researches in Physical Geography and Geology, by D. T. Ansted, *Esq. M.A. F.R.S.*

Lecture II. *Depths of the Atlantic.*

In the last lecture I directed your attention to the surface phenomena of the Atlantic Ocean. To day I must ask you to follow me while I attempt to explain what is known of the great body of its waters, altogether concealed from direct observation—of its ocean floor, that bed or foundation of earth on which it rests—and of the inhabitants, if there be any, of those depths, where no ordinary fish or other tenant of its upper strata could exist, owing to the vast pressure of the column of water overhead, and the very density of the water itself, squeezed by this superincumbent weight.

It is only very lately that we have begun to have definite ideas as to the real depth of what sailors call blue water, and in this, as in so many cases, a great necessity, arising out of the wants of civilised nations, has been the mother of discovery, and of that invention by which the required knowledge has been obtained. It is to the want of direct and rapid communication between Europe and America, of a communication not inferior to that which we now have between most cities of Europe by means of the electric telegraph, that the inventions and discoveries are due which I now proceed to explain. Electric communication, at present only obtained through the agency of a wire connecting one station with another, is practically the only means known of obtaining an instantaneous transmission of signals, and thus the problem has been to lay down a wire or group of wires from one station to another. I need not point out to you the mode in which this is effected, or the nature and necessity of the insulation required on land; nor need I waste time in explaining the contrivances found sufficient, when it is necessary, to carry the wire through the earth. In crossing seas of small width, as from Dover to Calais, where the depth is inconsiderable and the strain very great, owing to the action of tidal and storm waves on the coast, and the occasional drifting of ships' anchors a cable is required of great strength, such as would be altogether impossible to convey if the distance were considerable.

In crossing other seas, wider, but still inland seas and channels, the strength of the cable has been adapted to the amount of strain estimated as probable, and experience has shown that in most cases the causes of injury have been underrated. Thus the cable recently laid between England and the Channel Islands has already been frequently broken in the few months that have elapsed since its first laying down, and the wear and tear near shore in an important tidal way has been generally found to destroy slight cables rapidly.

You will see on the table, and can examine, some of the different sorts of cables employed for such purposes. Their strength is in proportion to their respective weights.

In order to ascertain the facts required to be known before laying down a telegraphic cable across the Atlantic, a number of inquiries were indispensable, and the nature of these will be clear if I name and explain to you very briefly the difficulties that might arise if the work of laying the cable had been undertaken in the dark. In the first place, the depth of the water might have been so great that no cable, however strong, could by any possibility have resisted the strain of its own weight in sinking. It is quite clear that if you have a cable consisting of a certain number of links, and suspend it from the top, the strain of the whole weight will be upon the point of suspension. If, therefore, the depth were sufficiently great to make it impossible to construct a cable strong enough to support its own weight when suspended in water, it would be quite impossible to reach the bottom of the Atlantic Ocean. It was, therefore, necessary that the limits of depth should be known, and if the cable were too weak for such depth it must of necessity have been broken and torn. When I tell you that the cable between Dover and Calais weighs eight tons to every mile, you will see that this was by no means an impossibility, and that the weight of the cable is of sufficient consideration to make it an element in the inquiries. Then again, supposing the depth were known, it was quite possible that the rocks at the bottom of the Atlantic might be very jagged and irregular. It might be such a surface as we have exposed at the top of the Alps, or the Himalaya mountains, or the Andes, a succession of peaks, and if the cable had caught on one of these peaks, and been suspended between that and another, there might have been considerable risk of its being worn to pieces by motion, or cut by the constant acting of its own weight upon those hard and sharp rocks, and thus the bottom might have been too irregular. Then the currents at the bottom of deep water might have been so strong as to have drifted the cable away, and to render it almost impossible for any average length to have been sufficient, because of the carrying away of the cable along the bottom. Another possibility was that, supposing the depth not to be very great, icebergs might be stranded on the bottom, or they might catch and drag along the bottom and create a considerable amount of mischief to anything which might be in the way. This was then another point they would have to consider. If, for example, the cable was carried by Iceland and Greenland, on the way to America, the action of icebergs might be sufficient to wear away and grind and destroy any cable placed there. There is another point to be considered from which injury might arise; whales might interfere with the cable even when it was once down—at any rate, if it were not fairly laid on a smooth surface it might be injured severely by them. It is well known that during the actual laying of the Atlantic cable considerable risk was incurred by whales coming nearly in contact. It might also have been that the temperature of the water at the bottom was so high that the gutta percha covering would be melted or softened, and the whole thus exposed to injury. Then again, it was impossible to guess at the quantity of cable that might be required, unless the distance at the bottom of the water across the Atlantic were pretty well known. The distance at the top was 1800 miles, and the quantity of spare cable depended upon the form of the bottom. All these points show clearly that there were difficulties to be encountered in laying the cable which rendered it necessary that something should be known of the bottom before the work was undertaken. The depth was the first thing to be determined, and in determining that most of the other points of interest were ascertained. Thus the temperature of deep water, the form, and the material of the bottom, were made out.

The ordinary mode of taking the depth of water is simply to throw out a lead with a piece of line attached to it, and this line being marked at known distances of fathoms, it is easy to see how many of those distances have passed out of the hand, and the depth is known at once as so many fathoms. When the number of those lengths of six feet becomes considerable, of course the method requires to be modified. This same method, however, with slight modification, is adapted to water which is tolerably deep, that is more than fifty or sixty feet, but not more than 200 or 300 fathoms. In the case of what is called deep-sea lead, such

as this [showing an apparatus on the table] being thrown over, the quantity of line running out is measured in pretty much the same way. At the bottom of the ordinary deep-sea lead there is a hollow space, in which it is usual to put some sticky plastic substance, such as tallow, by which means, when the lead strikes the bottom, small stones, or shells, or mud, are brought up, or if nothing is lifted, the form of the bottom is often marked upon the tallow. Thus the sailor can tell whether he is sounding a rock bottom, a sand bottom, a shell bottom, or whatever it may be, and from 100 to 2000 feet these matters can be determined with tolerable certainty. The line must be pretty strong for great depths, and such line must of course weigh something. To the depth I have mentioned there is no great difficulty in sounding and bringing up the weight attached to the line; but suppose a lead of the same kind, with a line attached to it, is let down to a much greater depth, say 500 or 600 or 1000 fathoms, instead of 2000 feet, in other words, suppose it has 6000 or 8000 feet of cord attached to it, it is quite clear that the weight of the cord must be very considerable, and may easily exceed that of the sinker. What will happen when a lead is let down under these circumstances? After a certain quantity of line is let out, the quantity of line will become so large in proportion to the weight of the lead, that currents of water will act upon the whole line as if there were no sinker, and will tend to drive the whole body forward in the direction of the currents. Where the depth is considerable, the weight of the lead will become so small in proportion to the line out, and the friction of the passing of that line through the water will be so great, that practically the sinking powers of the lead will cease to act. The deeper the water the greater the weight of the line, and the greater the weight the heavier, the stronger, and the greater the line must be to go down. There is also a considerable difficulty in bringing the line up again. It is required to sink the line to the bottom to learn the depth, and then to bring it up to see what the bottom consists of. In some cases fifty thousand feet of line have been run out without any bottom being reached, yet in all probability the bottom of the water was not more than ten thousand feet, therefore the whole of the rest had drifted away. Some contrivance was thus found necessary to enable persons sounding to find out when the sinker had got to the bottom, and also that the sinker should reach the bottom without drifting. A great many contrivances, some of them very ingenious ones, have been adopted for this purpose, but until within a very few years it never was possible to ascertain with certainty any great depth of water, so that soundings of blue water were looked upon by sailors of intelligence as unattainable, and by ordinary sailors as impossible, so that the depth of the sea has been practically unfathomable. But difficulties of this sort may be got over by mechanical contrivance, and we have to thank our neighbours on the other side of the Atlantic for an idea which, when fairly worked out, promises to answer all the requirements for deep soundings. Lieut. Brookes, U.S.N. was the inventor of this apparatus. The great difficulty was, as we have said, first to reach the bottom without any very great drift, and then to bring the line up again. Now a cannon ball is a sort of thing which, if thrown into the sea, would get to the bottom as quickly as most things, though not quite so quickly as this [pointing to a long cylindrical deep-sea lead], where there is less friction. Lieut. Brookes's idea was that by boring a hole through a cannon ball, and passing an iron rod through it, and then suspending the cannon ball on a saucer by means of a couple of ropes, in such a manner that the sinker or cannon ball dropped off at the instant the rod touched the bottom, he would be able to bring up the rod alone with the line without difficulty. In this way he would have to let down an iron rod weighing fourteen or fifteen pounds, to which was attached a weighty cannon ball of fifty or sixty pounds to be dropped off the moment it got to the bottom. The moment the bottom was reached the strain on the rope would thus be relieved, and the line could be lifted without difficulty. Thus the practical difficulty was overcome. Certain modifications of this apparatus have been made, and the apparatus has been adopted by the British navy in the form now exhibited. [Here the Professor explained the deep-sea sounding apparatus constructed by the late Mr. Massey, well known in connection with the patent sounding apparatus which has been used with success in the old method of soundings.] Mr. Massey has been kind enough to allow me to exhibit his apparatus to-day. It is a very useful modification of Lieut. Brookes's apparatus. It consists of a long rod suspended by two rings, by which it may be sunk or lifted. The whole is thrown overboard in the state exhibited, the heavy weight being supported on a small dish at the bottom, and kept in place by two rods having eyes at the extremity. The eyes are placed upon the hooks, and the moment the weight is taken off by the side rod having touched the bottom, the weight sinks, the pan sustaining it becomes detached, and the rest of the apparatus may be easily lifted. At the moment when the sinker falls off, and its side or supporting rods are detached, a small leaden weight sinks down to the bottom, closes a valve which is there, and encloses a portion of what there may be at the bottom of the ocean. The material which is thus brought up will sometimes amount to a pound in weight. The recess will hold any object of the size of a large pea, and indeed it will hold a moderately sized shell. This very simple apparatus is now applied to obtain the depth of the Atlantic, and to bring up the mud from the bottom of the ocean. In using it different kinds of line are required, and very large quantities of line, and considerable time, but the time now is so much reduced by means of this apparatus that what used to take six or eight hours even during calm weather and with every possible condition in its favour, is now done in about two hours, not merely in favourable weather, but while it is blowing briskly and in a heavy sea, so that the facilities for ascertaining the soundings of deep water are so much increased that there is but little difficulty beyond that of having the ship adapted to this contrivance and able to lift the rod with facility when it is out at great depths. It may be supposed that the lifting of a rope of perhaps a ton weight, and a very small additional weight of ten or fifteen pounds for the apparatus, is a small matter, but it is not so. It takes the full power of a twelve horse engine, with steam at a pretty high pressure. To lift a ton weight of line from the bottom of the sea a vast amount of friction has to be overcome. This friction shows itself by actually forcing the tar out of the rope. The pressure is so great that the rope is often strained and injured. The actual depth obtained by this contrivance has not at present reached beyond between five and six thousand fathoms. Whether there are greater depths than that, no one can yet tell; at all events there does not appear to be much of it in the Atlantic Ocean. I have suspended here a diagram shaded to point out the results, and I also exhibit some diagrams which show the results of the only great system of soundings across the Atlantic Ocean. This great system of sounding was done in connection with the original plan for carrying the telegraph cable from the west coast of Ireland to Newfoundland. The points were first of all determined by Captain Berryman, U.S.N. in the United States steamship Arctic, and afterwards by Captain Dayman, R.N. in H.M.S. Cyclops. They differ slightly from each other, but not very much. They were not made exactly on the same line of ocean, but very nearly so, and the general result is the same in both cases. Perhaps I should say that in the case of the Cyclops the soundings were taken at intervals of somewhere about fifty miles across deep water, and about ten or fifteen miles before deep water was arrived ot. The result showed that for some 250 miles west of Ireland the sea was comparatively shallow, so that there was scarcely any difficulty in getting ordinary soundings. In fact the first 250 miles were little more than an extension of the sort of sea bottom in the British Channel and in the German Ocean.

It was however shallow water only in the large sense of the word, in the sense of the great ocean, which is very much deeper, The extreme depth along the whole distance is nowhere more than about 600 fathoms. So far there was nothing very remarkable. Something of the same kind was observed on the American side, but there the depth was a little more, and the deepening more rapid, the whole of the result not being more than I have described. Now that may seem to be considerable, but it is in fact very small indeed if you compare it with a similar extent of land. Take 250 miles of Europe, and you will not find there anything so regular. It is not much more than half the height of the Welsh mountains. But then comes the extraordinary part: from that point about 250 miles west of the west coast of Ireland the next sounding taken at a distance of only a few miles went down to 1750 fathoms or 10,500 feet, the depth thus increasing enormously for so short a distance, and this great increase was the first intimation of deep water in the proper sense of the word. But this might be a gorge; such gorges exist on land, though hardly to that extent. It is a sudden drop of 8000 feet, a greater depression than is seen on the south face of the Alps. Supposing that this depression marked a gorge, we might then have expected that the bottom would rise immediately with more or less rapidity, as is seen in mountain districts where great depressions are succeeded by great elevations, but on going on with the soundings it was found that the depth continued nearly the same: there was indeed a small rise, and then a very small depression again, but with this exception the bottom remained at the same depth till near the American side of the ocean. The bottom, therefore, was totally unlike the great tracts of land with which we are acquainted. I do not say it is totally unlike all the land, but it is unlike all we know of Europe and Asia, and also unlike what we know of America This remarkably level extent of sea bottom greatly depressed, but not involving much change of character across the whole Atlantic, is what is called in America "the great telegraphic plateau." The telegraphic cable, if laid upon it successfully, would have laid there permanently. The soundings that determined this were very satisfactory, and the result was exceedingly important. Other results have been obtained since from other parts of the ocean, and in a general way the map of the ocean floor of the Atlantic (exhibited as a diagram) will show you to what extent that floor is level. I do not mean to put this diagram before you as a finished or correct view, but it is in a general way the result of what has been ascertained partly by United States surveying ships and partly by British vessels. It will be understood by looking at it. The very darkest parts are the land, the next dark parts are those depths of water which are not more than a thousand fathoms. The next shade marked No. 2 on the diagram, represents a depth of between one and two thousand fathoms, and so on. You may observe by the part left untinted that there is a large depression on the American side near Newfoundland. It is believed that there is a hollow having something of the same form as that represented, but it is right to remark that the soundings of that extreme depth are not quite so satisfactory as some others. The depth is however at any rate above 30,000 feet in some parts, but whether it amounts to 40,000 is doubtful. Another fact is remarkable: that in the middle of the Atlantic, a broad tract of less deep sea extends southwards from the upper termination of deep water. The shallower sea bottom here projects as a kind of tongue. The Atlantic islands are chiefly in the shallow water on the side towards Africa, and the whole of the Gulf of Mexico is comparatively shallow. There is, however, a channel of very deep water running through the Atlantic on the American side, so that the separation between Europe and Africa on the east and America on the west is a very marked and real one, and the canal or channel of the Atlantic is also real, although not extremely wide; the great depths of the Atlantic occur along its course.

(*To be continued.*)

CORRESPONDENCE.

On the Explosion of Hypophosphite of Soda.

To the Editor of the Chemical News.

Sir,—It was with considerable interest that I read in No. 29 of the Chemical News, the communication of M. Trommsdorff, relative to the ease with which hypophosphite of soda may be decomposed with explosive violence. About a year and a half or two years ago, I had occasion to superintend the manufacture of considerable quantities of the hypophosphites of lime and of soda, and although the preparation of these salts proceeded continuously for several months, I never observed the slightest tendency to explosion on their part. It may be important to observe that, except in the preliminary experiments, the temperature at which the solutions of the hypophosphites were evaporated to dryness never approached 212° F., the heat employed for this purpose being that emitted from a circuitous brick flue passing through a closet fitted up with shelves, upon which the shallow pans containing the solutions were placed. When the dry hypophosphites were stirred or shaken in a dark room they became highly phosphorescent.—I am, &c.

Richard V. Tuson.

Charing Cross Hospital.

Epsom Salts or Poison.

To the Editor of the Chemical News.

Sir,—In the Chemical News for June 9th, Mr. Thomas Salter proposes protosulphate of iron as a distinguishing test between oxalic acid and Epsom salts, and a note appended gives two simpler methods, viz. — by heating on a spatula, and by tasting the substance. It appears to me, however, that these methods cannot be depended upon in cases where the two substances are mixed (or when the oxalic acid occurs as an oxalate of potash), as in the heating test a residue would of course be left on the spatula, and in tasting a crystal of the Epsom salts would be as likely to be taken up as one of oxalic acid. In both of these cases there is at least a *chance* of error, sufficient to lead an inexperienced druggist's assistant, with no knowledge of chemistry, into selling a poisonous mixture.

Now as protosulphate of iron gives the yellow colour if oxalic acid be present, whether mixed or not, it appears to me to be a far more satisfactory proof of the presence or absence of oxalic acid than the other two methods, which are only applicable when the two substances exist by themselves.—I am, &c.

Henry Matthews, F.C.S.

Explosive Properties of Oxalate of Peroxide of Mercury.

To the Editor of the Chemical News.

Sir,—Having two days ago prepared a small quantity of oxalate of mercury, I allowed it to remain on the sand-bath drying until this morning, when it exploded with great violence, breaking the basin and dispersing the fragments so effectually, that not more than three or four pieces have been found, and these do not exceed in size half a finger nail.

I was absent at the time of the occurrence, but have had the relation of the circumstance from my father, who, in fact was reaching out his hand to remove the basin at the moment the explosion occurred, having perceived signs of decomposition going forward, puffs of gas coupled with sharp crackings, having for some seconds issued from it. Several of the fragments struck him in the face, but fortunately did him no serious injury.

When I arrived I found some half-dozen panes of glass situated about twenty feet distant from the basin, broken by flying fragments, one piece of apparatus was broken, evidently by the concussion, and the whole of the tables, even at the farthest point of the laboratory, were covered with sand projected from the bath.

I send you this account because it appears to me that this salt (oxalate of the *peroxide* of mercury) appears to be more explosive than the books would lead us to imagine. Gmelin says that it decomposes with a hissing noise. According to this author the mercurous oxalate appears to be more explosive than the mercuric; for speaking of the former salt, he says: "When suddenly heated in a glass tube it detonates." It is possible that a portion of the salt I prepared (which was not more in quantity than from 1 to 2 ounces) might have been reduced to mercurous oxalate, but whether that was the case or not, it certainly decomposed with more than a hissing noise.—I am, &c.

PETER HART.

Chemical Notices from Foreign Sources.

I. INORGANIC CHEMISTRY.

Preparation of Iodic Acid.—Kämmerer gives the following process for the preparation of iodic acid on the large scale. Iodine is dissolved in saturated baryta water which forms iodide of barium and iodate of baryta: these are separated by filtration. A stream of chlorine is passed through the filtered solution, whereby the iodine is precipitated in a very finely divided state favourable to its oxidation. When only a small quantity of the acid is wanted, the iodine may be oxidised directly by means of the strongest nitric acid. This plan succeeds well when the nitric contains no hyponitric acid, and the quantity of iodine operated upon does not exceed 10 grammes. The iodide of barium may be changed into iodate by dropping it in small pieces into fused chlorate of potash.

Preparation of Bromide and Iodide of Potassium.—Professor Dr. A. Buchner has proposed the following formula for the second edition of the new Bavarian Pharmacopœia: — 2 oz. iron filings and 18 oz. of distilled water are mixed in a flask with 3 oz. of bromine, gradually added, and agitated until the liquid has assumed a greenish colour, when it is filtered, and the filter washed with distilled water. This liquid is added to a solution of 1 oz. of bromine in a sufficient quantity of diluted caustic potash; most of the iron is then precipitated with caustic potash, and the precipitation of the heated liquid is completed by the careful addition of a solution of carbonate of potash. After standing several hours, the precipitate is filtered, washed with distilled water, evaporated, and allowed to crystallise as long as pure crystals are formed, which are to be quickly washed with a little cold water and dried.

For *iodide of potassium* the formula is like the preceding, except that for 2 oz. iron, 36 oz. water and 6 oz. iodine, and for the second solution 2 oz. iodine are employed. The author proposes, after Liebig's suggestion to dissolve, instead of one-third, one-fourth of the whole iodine or bromine employed in the caustic potash, in order to precipitate, not hydrated sesquioxide, but the magnetic oxide of iron, which is less voluminous, and therefore more easily washed.

II. ORGANIC CHEMISTRY.

Chemical Composition of the Arbutus Fruit.—M. Filhol writes[2] that the ripe fruit of the arbutus contains an uncrystallisable sugar, which rotates the plane of polarisation to the left, reduces the double tartrate of potash and copper, and possesses in fact all the properties of fruit sugar. Besides this the fruit yields to cold water a substance which is precipitated by alcohol in the form of a transparent jelly. When purified by repeated solution and precipitation, it is found to have all the characters of parapectine. It is entirely precipitated from its solutions by neutral acetate of lead which pectine is not. Parapectine has never before been found in a fruit. A yellow substance very like wax is also found, and a colouring matter which becomes of a beautiful violet tint in contact with potash, and yellow in contact with acids. Lastly the fruit contains metapectic acid and traces of starch.

Crystals in the Bark of Guaiacum.—Dr. Otto Berg and others have observed a large number of very small, colourless, and bright crystals upon the inner surface of the bark of guaiacum, which therefrom receives a peculiar lustre. Guibourt declared them to be benzoic acid. Richard and Trommsdorff thought them crystallised resin of guaiacum, of which the bark contains about 2·5 per cent. In Liebig and Wöhler's *Handwörterbuch*, there is a paper on guaiacum by Dr. Städeler, who thinks it not improbable that the crystallised body might be the guaiacin, observed by Landerer in the sediment of a tincture of guaiacum. Dr. Berg[3] finds them to be nothing else but gypsum. These crystals are found not only upon the inner surface of the bark, but are evenly distributed throughout the whole inner portion, and may therefore be readily recognised upon the thin lamellæ into which the bark may be split after a short maceration in water; each of the cells of the parenchyma, which are placed in very regular rows, contains a single crystal which occupies nearly their whole interior. If the crystals are heated, they assume a milk-white colour, which is characteristic of the crystals of sulphate of lime. A similar change, under somewhat different conditions, may be observed, if a very thin longitudinal section of this interior bark in a tangential direction is incinerated. If it is carefully moistened with water, it will be observed that the crystals have changed their colour to a milk-white, but have remained in their respective positions. Reduced to sulphide of calcium by the carbon of the cellulose, they are dissolved with effervescence on the addition of nitric acid, and the evaporated solution again yields prisms of sulphate of lime in star-like groups, but considerably smaller in size.

The same twin-crystals of gypsum are likewise found in the inner bark of other plants; for instance, in the bark of Swietenia Senegalensis, and in a somewhat different shape in the bark of Pterocarpus Massupium. The crystals of gypsum in the parenchymous cells of the various species of Musa are of various shapes, and are always found in a larger number in the cells, which are never entirely filled by them.

[1] *Journal für Prakt. Chem.* Bd. lxxix. 5. 94.
[2] *Comptes-Rendus*, t. l. p. 1185.
[3] *Archiv d. Pharm.* 155, 156.

LABORATORY MEMORANDA.

Detection of Oxygen in Hydrocarbons, &c.—SIR,—Dr. E Unger has fallen into a complete series of mistakes, owing to his not being aware that wood-spirit is frequently sold by shopkeepers under the very incorrect title of "naphtha." From Dr. Unger's statement that he put his naphtha into a spirit lamp for use, it is plain that he is also unaware that fluids capable of being employed in spirit lamps are unfit for the preservation of potassium.

Wood-spirit and alcohol, as every chemist knows, or should know, form highly important compounds when treated with the alkali metals. Dr. E. Unger says: "From these results I judge that potassium must be a very reliable test for the presence of oxygen in hydrocarbons, either accidentally or by adulteration." To this judgment of Dr. E. Unger's it may be answered, that chemists have extensively employed potassium, sodium, and the fluid alloy of these two metals, in their researches on hydrocarbons for upwards of twenty years. The last two volumes of the *Chemical Gazette* give several important instances of this use of them. I do not wish to comment in an illnatured manner upon Dr. Unger's memorandum, but I must place on record my conviction that before mentioning as new or little known reactions with which students of organic chemistry are familiar, it would be well to refer to a few elementary works on the subject.—*Hydrocarbon.*

MISCELLANEOUS.

On the Value of Coal, and the Necessity of Economy in its Use.—However other circumstances may have conspired to raise Britain to pre-eminence in arts, manufactures, and commerce, its store of valuable coal is unquestionably the grand basis which has sustained the whole.

The present enormous consumption of coal, with the wasteful modes of working and using it, demands the serious consideration of the philosopher, while the prospect of its final exhaustion at no distant period, must fill the minds of the patriot and philanthropist with feelings of the most intense anxiety.

The present generation seems to rest satisfied with the idea that coal will last their time, and that of their children and grandchildren; and even should the conviction be forced upon the minds of any that the coal in the northern and midland counties of England is rapidly diminishing, it is the fashion to point to the coal field of South Wales as a source from whence an almost unlimited supply may be drawn, after all the other beds have been worked out; but this is a great fallacy, inasmuch as the extent of the supply from that quarter has been always sadly over-rated.

The continuance of the smoke nuisance in towns and manufactories evinces a disregard to economy, to the public comfort, and to the dictates of the philosopher who has laboured to inculcate the true principles of heat and combustion.

The object of the present notice is to point out to the inhabitants of the Metropolis an improved system of domestic economy by the use of gas instead of raw coal. The present daily average consumption of coal in and around London, is upwards of 9000 tons throughout the year; during winter it must far exceed this! That such a mass of bulky material should be transported upwards of 300 miles and distributed over London daily, is startling and almost incredible.

The practicability and advantages of using gas for cooking and other domestic purposes are now fully established.

A most powerful and economical gas may be formed by saturating steam with carbon. The gas should be manufactured near the collieries, in large furnaces similar to iron furnaces, but not so lofty, and by an alternating operation; that is to say, by successively blowing in air to raise the coal and furnace to a high heat, during which time the products of combustion must be allowed to escape, and then throwing in steam to form gas.

The steam heated by the gasses passing off, is to be introduced at the upper part of the furnace, and confined so as to force its way downwards through a dense mass of highly heated coal, by which means it will become fully charged with carbon.

Between these two alternations a portion of fresh coal is to be introduced into the furnace. The gas thus obtained will consist of equal volumes of carbonic oxide and carburetted hydrogen, together with the gas of the fresh coal.

Carbonic oxide is an important gas, but chemists and gas engineers entertain many erroneous notions respecting it. This arises from the difficulty of forming true carbonic oxide on a small scale; because, if any carbonic acid should be present, it renders the gas worse than useless; hence these mistakes.

One set of gas holders must be provided near the works, from whence pipes must be laid to London, where another set of gas holders must also be provided: into the latter the gas will require to be forced by air pumps, drawing the gas from the pipes. In the outset the gas may be laid on to the stove grates at present in use, which are to be filled with an incombustible non-conducting material, such as pieces of porcelain, biscuit, or broken fire-bricks, having an arrangement for regulating the supply of air. When a fire is required, it will be necessary only to turn on the gas and apply a lighted lucifer match. The advantages of this system to the housekeeper will be economy and cleanliness; there will be no further occasion for coal-cellars, fire-wood, ash-bins, or attendance upon fires; no soot, consequently no sweeping of chimneys. The advantages to the public would be, that the atmosphere of London will be free from coal smoke, the streets and thoroughfares will be relieved from the obstruction of coal-waggons, the Thames above bridge from that of coal-barges, and below bridge from that of fleets of colliers. The national benefits will be saving of coal, and a proportionate prolongation of Britain's prosperity and power.

The New Houses of Parliament. — Some days ago, as police-constable 112 A was on duty in Palace-yard, near the entrance leading to the reporters' gallery, a large mass of stonework, forming the canopy to the niche containing the statue of Charles the Second, broke away and fell to the ground with great violence from a height of about 50 feet, and within a foot of where the police-constable was standing, smashing the pavement by the violence of the concussion. The only reason that can be assigned is the very rotten and rapidly decaying condition of the stone in different parts of the building, especially in those parts where there are ledges or projections.

It is evidently quite time that the Commissioners made their report on the Stone Preserving Processes, so that something effectual may be done to stop the progress of the decay.

New Explosive Compound.—Mr. Harrison, of the Greenacres Grammar School, has discovered a chemical compound possessed of the most destructive qualities, at the same time the elements being of the most simple and innocuous nature. They can be handled singly with the greatest impunity, but when combined their effects are most terrific. From careful experiments made by the discoverer, the strength of the compound is from seven to twelve greater than gunpowder, according to the mixture; and it has these further advantages, that it can be manufactured at one-third the price of powder, and is explosive during the whole of its operation, and not merely flashy, as is the case with gunpowder. The heat emitted from it is most intense, and the gas generated deadly. It is perfectly adaptable for shells, congreve rockets, and similar missiles, as well as for blasting purposes. If fired from a rifle in a small shell it will explode when it comes in contact with a hard substance, and if it penetrates it still will continue burning in the body of the material; and although apparently extinguished, it will again blaze forth with renewed intensity. For exploding magazines, setting fire to the sails of ships, or destroying military luggage, it would be most invaluable. A small shell for a breech-loading rifle three-fourths of an inch by five-eighths diameter would only amount to three-halfpence. Mr. Harrison is still unostentatiously pursuing his investigations, and it is to be hoped that his discovery will turn out what he now designates it—a "peacemaker."—*Oldham Standard.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Medicus. — You would probably get the shade by a mixture of red and blue. See the purple colours in *Cooley's Dictionary*.

Practical Chemist. — There is no English translation of *Chevreul on Fats*. We do not know the price of the French Edition, which may be procured through the foreign booksellers.

J.E. asks, "Would you or any of your numerous correspondents say what is the most economic way of making Sulphate of Aniline?" All the processes we know at present are open to the objections our correspondent makes to his own, but we will see whether any other correspondent will oblige him.

W. D.—We have not lost sight of the matter.

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On an apparent Perturbation of the Law of Definite Proportions observed in the Compounds of Zinc and Antimony, by JOSIAH P. COOKE, *Jun. Cambridge, U.S.*

(*Concluded from Vol. I. p. 303.*)

General Conclusions.—Before stating the conclusions to which as I think the facts now established directly point, it will be well to consider the only two admitted principles of chemical science which could possibly be brought forward to explain similar variations. They are, first, that of impurities in crystals; second, that of isomorphous mixtures. It will not be difficult to show that the variations in composition of Sb Zn_2 and Sb Zn_3 cannot be caused by either of these principles.

It is a well known fact that crystals frequently take up impurities which are either dissolved or mechanically suspended in the menstruum in which they form, and it might be supposed at first sight that the excess of zinc or antimony in Sb Zn_3 or Sb Zn_2, bore the same relation to their crystals that the sand does to the rhombohedron of calcite from Fontainebleau, or oxide of iron and chlorite to crystals of quartz; but, in the first place, in all cases where a considerable amount of impurity is present, the crystals are either imperfect, or else the angle is considerably changed, at times even as much as two or three degrees; and secondly, as such impurities are merely mechanical, the amount in the crystals would in all probability be proportional to the amount present in the menstruum at the time of their formation. Now in the crystals of Sb Zn_3, from the alloy of 60 p. c. of zinc, there is present an excess of zinc amounting to 15 p. c., and nevertheless the crystals are as perfect as, and their angles identical with, those obtained from the alloy of 43 per cent. In the crystals of Sb Zn_3 the excess of zinc is to a certain limit directly proportional to the excess in the alloy, but in those of Sb Zn_2 the excess of antimony is far from obeying this rule; and were the excess in both cases a mechanical mixture, the variation in both cases would undoubtedly follow the same law; again, the crystals of Sb Zn_3 take up an excess of zinc but do not take up an excess of antimony, while those of Sb Zn_2 crystallise with an excess of either, facts which are as inconsistent with the idea of mechanical impurity as the last; finally, the form of the curve of Sb Zn_2 of itself alone proves that the excess of antimony in the crystals is not in the condition of mechanical impurity, for in that case the variation of composition would not be influenced, as the curve shows that it is by the chemical force.

A theory that the variation in composition resulted from the mixture of two or more isomorphous compounds would be even less tenable than the one just discussed, for in the first place it would be necessary to assume the existence of two other compounds of zinc and antimony isomorphous with Sb Zn_2, and of one other, if not more, isomorphous with Sb Zn_3. Not only would such an assumption be contrary to all the analogies of chemistry, and therefore require strong evidence to sustain it, but in the second place it can almost be demonstrated that no such compounds exist. The crystals having the calculated composition of either Sb Zn_3 or Sb Zn_2, are marked, as has been shown, by striking peculiarities, and with one possible exception similar peculiarities were not observed throughout the whole series of crystals which have been examined. The crystals containing 50 p. c. of zinc and of the composition of Sb Zn_4 were found to have a slightly smaller sp. gr. than those just above or just below them, but the difference is so small that it may be accidental, and as the crystals exhibited none of the other peculiarities which characterise crystals having the calculated composition of Sb Zn_3 or Sb Zn_2, I could not attach sufficient weight to the one circumstance to feel authorised in admitting a third compound of zinc and antimony. Admitting, however, the existence of Sb Zn_4, yet, as exactly the same angle has been observed in crystals containing 55 p. c. as on those containing 43 p. c. of zinc, it would be necessary, in order to explain the variation in composition by the principle of isomorphous mixtures, to assume the existence of still a third compound isomorphous with Sb Zn_3, and containing more zinc than Sb Zn_4, which would increase greatly the improbability of the theory in question. Again, the only probable compound of zinc and antimony containing less zinc than Sb Zn_3 would be Sb Zn; and it will be remembered that the crystals of Sb Zn_2, which contained the largest excess of antimony, corresponded very nearly to this compound. In like manner the crystals of Sb Zn_3, which contained the largest excess of zinc, corresponded very nearly to Sb Zn_3. If then the excess of antimony or zinc in the crystals of Sb Zn_3 arises from a mixture of isomorphous compounds, it must be that Sb Zn_3, Sb Zn_2, and Sb Zn, are isomorphous. That the first two are not isomorphous may be seen by turning back to the description of their crystalline form, and that there is no crystalline compound Sb Zn is sufficiently proved by the fact that the crystals of Sb Zn_2, which correspond most closely to it, are so very imperfect that they would hardly be recognised as crystals did they not form the lower limit of a series. Several other facts pointing in the same direction might be added, but sufficient, it is thought, has been said to show that the variations of composition described in this paper cannot be explained either by mechanical impurities in the crystals or by the mixture of isomorphous compounds.

In the absence of any known principle of chemical science by which the remarkable variations of composition that have been demonstrated in this memoir can be explained, the conclusion is almost forced upon us that zinc and antimony are capable of uniting and producing definite crystalline forms in other proportions than those of their chemical equivalents; in other words, that the law of definite proportions is not so absolute as has been hitherto supposed. The explanation then of the varia-

tion of composition which I would offer is—that it is due to an actual perturbation of the law of definite proportions produced by the influence of mass. I suppose, for example, that in the crystals of Sb Zn_3, containing 55 p. c. of zinc, the zinc and antimony are united in exactly the same way as in those containing 43 p. c. or in other words, just as if the equivalent of zinc were increased to 52·57, that of antimony remaining the same. In support of this position I would offer two considerations; the first is that if the variation is not caused by mechanical impurities, or by the mixture of isomorphous compounds, we can conceive of no other explanation for the phenomenon than the one offered. This of course is merely negative evidence, for although science as yet presents us with no principle for explaining variations of composition other than those which have been discussed, and although we can conceive of none others, it does not follow that others may not exist, or may not hereafter be discovered; but, nevertheless, this consideration is important, inasmuch as it meets an obvious objection which would be urged against any new doctrine which conflicts with a generally received canon of chemical philosophy. The second consideration has the character of demonstration. It is that the variation is evidently generated by a second force counteracting directly the chemical force. This second force, as has been shown, is exerted by the excess of one or the other element present in the menstruum, and it may therefore be appropriately termed the force of mass. What the nature of the disturbing force is must be for the present a matter of theory. I am inclined to think that it is a phase of the chemical force itself, in the same way that the perturbations in the motions of the planets are a secondary result of the force of gravitation.

Accepting the view of the subject which has been offered, it will be obvious that the very large extent of the variation in the compounds of zinc and antimony is due to the very weak affinity between these elements. Were the chemical force stronger in proportion to the disturbing force, the variation would be lessened; were it weaker, the variation would be increased. This is illustrated in the difference between the curve of Sb Zn_3 and that of Sb Zn_2. It is evident from the action of chemical agents on the two compounds, that one equivalent of antimony and two of zinc are united by a stronger force than one equivalent of antimony and three of zinc, and we find that the crystals of Sb Zn_2 retain the calculated composition under a considerable variation in the composition of the menstruum, while the composition of those of Sb Zn_3 varies with the slightest increase of the amount of zinc in the alloy.

To what extent this perturbation of the law of definite proportions prevails among chemical compounds, it must remain for future investigation to determine. There are however a number of facts which tend to prove that it is very general whenever chemical affinity is weak. Four of these I will cite, as being remarkably analogous to the facts under discussion:—

1. Rieffel, to whose investigation of the compounds of tin and copper we have already referred, says, after the paragraph quoted in the introduction to this memoir, "Les aiguilles de $CuSn_2$ sont plus grosses que celles de $CuSn_4$." "*On croit, sans oser l'affirmer, qu'elles sont, par compensation, en nombre moindre, et que des différences analogues ont lieu dans les autres* $CuSn\phi$ *à mesure que* ϕ *augmente jusqu'à* $\phi=\infty$, *ou jusqu'à l'étain pur.*" It will be noticed that the difference between these needles is precisely the same as the difference between the crystals of Sb Zn_3 containing a small and a large amount of zinc, and I think that no one, after reading Rieffel's paper, can doubt that the compounds of copper and tin vary in composition like those of zinc and antimony.

2. The mineral Discrasite, a compound of silver and antimony, crystallises in trimetric prisms, of which I on $I=119^\circ\ 59'$.[1] The analyses given below are copied from *Dana's System of Mineralogy*, changing slightly the order.

Sb Ag_3 = Antimony 28·5 Silver, 71·5 = 100. Sb Ag_4 = Antimony 23, Silver 77 = 100.

1. Andreasberg (foliated granular)	Antimony 34·25	Silver 75·25 = 99·5,	*Abich.*
2. Wolfach (coarse granular) . .	„ 24	„ 76 = 100,	*Klaproth.*
3. Andreasberg (foliated granular)	„ 23	„ 77 = 100,	„
4. „ „ „	„ 25	„ 78 = 100,	*Vauquelin.*
5. Wolfach (fine granular) . .	„ 16	„ 84 = 100,	*Klaproth.*

It needs no comment on these results to show that Discrasite is homœomorphous with Sb Zn_3, and varies like it in composition.

3. In a paper published[2] by W. Sartorius von Waltershausen, he gives descriptions and then analyses of a new mineral occurring with Dufrenoysite in the Binnen Valley, Switzerland, in Dolomite. As the analyses do not agree with each other, and do not correspond to a simple formula, von Waltershausen regards the compound as consisting of two hypothetical isomorphous compounds Pb S + $As S_3$ and 2 Pb S + $As S_3$, and calculates the proportions in which these compounds are mixed in the specimens analysed. He infers that they are isomorphous from their analogy in composition to Zinkenite and Heteromorphite, Pb S + $Sb S_3$ and 2 Pb S + $Sb S_3$, which he regards as isomorphous. Prof. J. D. Dana questions the isomorphism of the last, and thinks that the hypothesis that the new compounds are isomorphous requires further evidence.[3]

4. It is stated by Staedeler[4] that crystals of the compound of grape sugar and common salt can be obtained containing for every equivalent of grape sugar one or two equivalents of chloride of sodium and also of intermediate composition. He states moreover that "Calloud, who first observed that the grape sugar of honey combined with chloride of sodium, found that the amount of the latter varied between 8·3 and 25 per cent." Staedeler refers the variation in composition to a mixture of the compound of one with the compound of two equivalents of chloride of sodium, which he assumes to be isomorphous. He adds that it may be caused by "enclosed crystals of chloride of sodium, although the eye could not distinguish any heterogeneous constituents."

All the above compounds are examples of weak chemical affinity accompanied by large variations in composition, without any change in the general crystalline form. It is not meant to assert that the variations are identical in character with those of Sb Zn_3 and Sb Zn_2, but only that there is a strong probability that this is the case, which in the first two instances amounts almost to a certainty.

If variations in composition of such magnitude are possible when the force of chemical affinity is weak, it is highly probable that some variation may occur when the force is strong, and, whatever view may be taken of the cause of the variation, it will now become a matter of importance to ascertain whether many discrepancies in

[1] *Dana's System of Mineralogy*, 4th ed. vol. ii. p. 35.
[2] *Poggendorff's Annalen*, vol. xciv. p. 115.
[3] *American Journ. of Science*, vol. xix. p. 355.
[4] *Chemical Gazette*, vol. xiii. p 44.

analyses hitherto referred to imperfections in the process may not be owing to the same cause which influences the composition of the crystals of zinc and antimony.

I am well aware that in announcing the existence of perturbations of the law of definite proportions, I am calling in question one of the most fundamental dogmas of chemical philosophy, and that the new doctrine will have to encounter prejudice on this very ground. This law is so intimately associated in many minds with the atomic theory, that, to such, absolute definiteness seems to be its essential characteristic; nevertheless, I cannot but believe that, laying aside the prejudices which the theory begets, it will be seen by all that the analogies of nature support the doctrine of variation as maintained in this memoir. The phenomena of some of the phenomenal [5] laws of nature have that definiteness of character which is claimed for those of the chemical law. The planetary orbits are not perfect ellipses. The ratios of the harmony scale are but approximately realised. The arrangement of leaves on the stem is not perfectly regular. Isomorphism is seldom absolute. In all we observe only a tendency towards a maximum effect, which is the perfect expression of the law, but which is rarely fully reached. The limits of variation are broader in some instances than in others, but we find no case in which there is absolutely none. This same character which pervades the other phenomenal laws of nature I claim for the great law of chemistry. The definite proportion I regard as a maximum toward which the chemical force strives, a maximum from which the deviations in most cases are small, although in others it may be very large; and I maintain that this view of the subject, which the memoir has aimed to establish, is supported by the analogies of nature.

When the dynamical law has been discovered, of which the phenomenal law was merely the outward manifestation, as Kepler's laws were merely the phenomena of the law of universal gravitation, the very variations have been seen to be necessary consequences of the law itself, and if even the dynamical law, which governs chemical phenomena, shall be discovered, it is most probable that the variations from the law of definite proportions will become as much a matter of calculation as the perturbations of astronomy. In both cases the perturbation is apparently due to the influence of an extraneous mass of matter.

The argument from analogy becomes stronger, when we consider the equivalent numbers. I have shown in a former memoir [6] that these numbers may be connected by a very simple numerical law, but here, as in other cases, we find merely a tendency towards the law, not an absolute agreement with it, the differences between the theoretical and the experimental equivalents being in many cases too great to be covered by errors of observation. The present memoir may throw light upon these discrepancies, for, to say the least, it is possible that the differences may originate in variations of the equivalent itself, and that the theoretical equivalent may be the maximum towards which the chemical force tends. On comparing carefully the different determinations of the chemical equivalents, many facts may be noticed supporting this view; those equivalents, for example, which coincide with or very nearly approach whole numbers, such as those of oxygen, carbon, and sulphur, will be found, as a general rule, to have been determined by the analysis or synthesis of compounds whose elements are united by a strong force; also when the equivalents have been determined by essentially different processes it will be noticed that they seldom perfectly agree, so that whatever view may be taken of the subject it will now become a matter of the highest importance to ascertain how far, if at all, the determinations of the chemical equivalents have been influenced by similar causes to those which have produced the variations described in this memoir. This influence can only be detected by multiplying the determinations by as many processes as possible, and submitting the results to a rigorous mathematical scrutiny.

If the doctrine of this memoir is correct, and the chemical equivalents are really liable to variation, it will have an important influence on chemical philosophy. The atomic theory, as at present interpreted by chemists, is irreconcilable with it, and our present ideas in regard to isomorphism must be materially changed. But it must be remembered that the conclusions of the memoir are drawn from the examination of only two compounds, and therefore that it would be premature to dwell on these obvious consequences of the principle until it has been substantiated by further investigations.

[5] I have used the term phenomenal laws to designate a class of laws of nature which are empirical in their character, inasmuch as they are obviously not ultimate, although their deviation has not been discovered, but which are more universal than those to which the term empirical is commonly applied.

[6] *Am. Journ. Science and Arts*, vol. xviii, p. 229.

TECHNICAL CHEMISTRY.

Properties of Coal—Artificial Fuel.

THE qualities of coal are extremely various, at the same time that there are certain peculiar properties which may serve to divide coal into three distinct classes, namely, 1st. Splint, or free burning coal; 2nd. Bituminous, or coking coal; 3rd. Anthracite, or stone coal. The solid elementary portion of all these is the same, that is to say, carbon, but mingled, in various proportions, with earthy or other matters. The gaseous or volatile portions of coal differ both in composition and proportions; in splint there are both hydrogen and oxygen, but the proportion of the latter to the former is always much less than in the composition of water. In true bituminous coal hydrogen alone is present, which is also the case with anthracite, but in the latter the proportion of gas is very small. The simple elementary gases are here only mentioned, but, of course, when these are expelled from coal by heat, they are always combined with carbon, varying in proportion according to circumstances. Its volatile constituents seem to influence the general character of coal.

The generation of steam has, at the present day, assumed a magnitude and importance which calls for the strictest investigation into the properties of coal best adapted to that particular purpose. As bituminous coal possesses the property of binding, or running together when heated, it is not adapted for use in the fireplaces of steam engine boilers, since it would be required to be continually poked to keep it sufficiently open to allow an adequate passage of air through it. As splint coal has little or nore of the binding property, it is preferred on that account, but in other respects its use is objectionable. The want of this binding property occasions a great loss of fuel, by portions of unconsumed combustible matter continually passing through the fire grate; at the same time that much of this description of coal having its elements so loosely combined that, on the first application of heat, the bulk of the gas flies off with great force, carrying with it a dense volume of solid matter, in minute particles, which pass off as a cloud of

black smoke. This is not only a great nuisance, but also an absolute loss of valuable fuel; besides which there is a great waste of heat, abstracted from the fire and expended in volatilising this volume of unconsumed matter, without effect in generating steam. Anthracite coal, when fully ignited, gives out a strong heat without smoke, and is very durable, but the heat of burning anthracite is merely what may be termed local or fixed, deficient in flame, and wanting that gaseous diffused action which is so essentially necessary to promote rapid evaporation in large boilers. Anthracite too is also deficient in all binding or adhesive property, so that there is a great loss in unconsumed particles dropping through the fire grate; moreover, some descriptions of anthracite from their vitreous structure have the property of decrepitating, shivering into small particles, when suddenly heated, thus choking up the fire, and finally dropping through the fire grate, slightly charred on the surface. Some years since I contrived a mode of burning anthracite by the use of a blast and water grate, by means of which an extraordinary volume of flame was produced, while the grate bars were kept comparatively cool, so that the pieces of coal immediately resting upon them did not burn away, and thus formed a bed for the highly ignited fuel above, which was retained there, until all combustible matter was consumed, and thus any loss of fuel was prevented. The difficulties which I experienced in my endeavours to introduce this principle, together with other more weighty considerations, determined me to attempt the formation of blocks of fuel, composed of different descriptions of small coal, so as to combine all the essential requisites of a good steam fuel. I found that where a mixture of coals, a fair proportion of which being coking coal, was suddenly exposed to heat in a close vessel, it ran together into a solid block. I have since contrived a set of castings, which may easily be arranged into moulds, and can be as easily drawn apart again, to remove the blocks of fuel when formed. I determined that the best mode of heating these moulds would be upon moveable hearths, and for this purpose I contrived a furnace consisting of a long archway, to be heated by blast fires, through which these hearths, having the moulds already arranged upon them, could be passed on wheels and rails. In order that any refuse small coal might be made available for forming fuel, I contrived a method of washing coal by forcing currents of air upwards through a bed of coal immersed in water, so as to carry off the lighter parts over plates arranged for the purpose, leaving behind the heavier portions, consisting of stones, slates, pyrites, and the larger pieces of coal. I found that when a mixture of coals, moderately moistened, was shot suddenly into a heated mould, the moisture, becoming steam, expelled all air from the interstices between the particles of coal, so that when suddenly cooled, by dashing water over it, the block became sufficiently compressed without any mechanical application. Fuel, prepared upon this principle, burnt freely without emitting any smoke; it seemed well adapted for use in the fire-place of any steam engine boiler, whether stationary, marine, or railway locomotive. Formed into blocks, it would economise stowage on shipboard; every surface being highly charred, would be a sufficient protection against the influences of weather and climate; the mode of preparation would be an ample guarantee for security against spontaneous ignition.

A lengthened and close scrutiny into the qualities and properties of coal, led me, as a natural consequence, to speculate upon the causes of such diversity, and this recalled to my recollection a circumstance which I witnessed in my early life. Being present when a considerable quantity of green vegetable matter was under treatment, one portion having been left saturated with water for several days, during sultry summer weather, upon being agitated I noticed the dense fumes of nitrous acid in great abundance. I can only account for this formation by supposing that decompositions, both of water and of vegetable matter, were going on simultaneously, the water furnishing oxygen, while the vegetable matter supplied the nitrogen, in this case fortuitously, in the requisite proportions to form nitrous acid.[1] The train of reasoning which this circumstance induces does not merely suggest the source from whence the varieties of all the quality and properties of coal may have arisen, but it points out a mode by which coal may be formed artificially whenever the occasion may arrive. Suppose a quantity of green vegetable matter to be left in a moistened state for a sufficient period, exposed to the temperature most favourable for promoting the decompositions alluded to, and afterwards to be subjected to the operation I have described for forming blocks of fuel, there is every reason to believe that coal, in a state of the greatest purity, might be formed by art in a brief space of time.

C. J. S.

Cellulose Digested by Sheep.

THE researches of several German chemists have proved that the cellulose of plants is by no means so indigestible a substance as was at one time supposed, but that on the contrary it is digested in considerable quantities, by the ruminants at least, especially when a portion of the food of the animal consists of some substance rich in oil.

In order to ascertain to what extent the digestibility of cellulose may depend upon its state of aggregation, Sussdorf and A. Stœckhardt have undertaken a series of experiments, of which only a very brief abstract can be here given. From their results it is evident that even the most compact kinds of cellulose can be in great measure digested by sheep. The experiments, commenced in July 1859, were upon two wethers, respectively five and six years old. These were fed—1st, upon hay alone; 2nd, upon hay and rye straw; 3rd, hay and poplar wood sawdust which had been exhausted with lye; in order that the sheep should eat the sawdust, it was found necessary to add to it some rye bran and a small quantity of salt; 4th, hay and sawdust from pine wood, mixed with bran and salt; 5th, hay, spruce sawdust, bran and salt; 6th, hay, paper-maker's pulp from linen rags and bran; after several unsuccessful attempts to induce the sheep to partake of the pulp when mixed with dry fodder, it was at last given to them in a sort of paste or pap, prepared by mixing bran with water. The experiments were continued until November, with the exception of a short intermission, during which the animals were put to pasture, in order that they might recover from the injurious effects—probably due to the resinous matters of the spruce wood—of the fifth series of experiments.

The animals, as well as their food, drink and excrements, were weighed every day. The amount of cellulose in the excrements was also daily determined by analysis. The composition of the food ingested having been previously ascertained.

It thus appeared that when the animals were fed —

[1] We print this statement of our author just as we received it.—ED.

(1.) with hay (35 lbs. per week), 60 to 70 per cent. of the cellulose contained therein was digested, *i. e.* it did not appear as such in the solid excrements. In this experiment the animals gained 7½ lbs. in 18 days. (2.) With hay 14 lbs. and straw 7 lbs. (per week), 40 to 50 per cent. of the cellulose of the straw was digested, the animals having lost 2½ lbs. in 11 days. (3.) With hay 10½ lbs. poplar sawdust 5½ lbs. bran 7 lbs. (per week), 45 to 50 per cent. of the cellulose of the poplar wood was digested, the animals having gained 2½ lbs. in 13 days. (4.) With hay 10½ lbs. pine wood sawdust 7 lbs. bran 10½ lbs. (per week), 30 to 40 per cent. of the cellulose of the pine wood was digested, the animals having gained 10 lbs. in 24 days. (5.) With hay 9½ lbs. paper-maker's pulp 7 lbs. bran 14 lbs. (per week), 80 per cent. of the cellulose of the paper pulp was digested, the animals having gained 7 lbs. in as many days.

These experiments are to be continued, and more particularly with a view of ascertaining whether any nourishing effect is to be attributed to the cellulose.[1]

PHARMACY, TOXICOLOGY, &c.

The Chemistry of Pepsin, by HARRY NAPIER DRAPER, *F.C.S.L.*

A DISCUSSION bearing upon the merits and demerits of pepsin has suggested the idea that a brief *resumé* of the present state of our knowledge of its chemistry may not be unacceptable to the readers of this journal. By treating of this succinctly under a few heads, I hope to present the most important bearings of the subject, and by avoiding extraneous matter, to claim from chemists and medical men more careful consideration of the mode of action of a probably very valuable remedy.

Composition of the Gastric Juice. — The best analyses of the fluid which is secreted by the gastric follicles show that it does not contain more than 1·72 per cent. of solid matter, and that while some small portion of this consists of alkaline and earthy chlorides and phosphates, by far the greater part is a peculiar organic body to which the name of *pepsin* has been given. Besides these the gastric juice contains a free acid. It would seem at first sight no very difficult matter to decide what this acid really is; but although the question has engaged the attention of many chemists, it can scarcely be looked upon as satisfactorily decided. Opinions have fluctuated between the hydrochloric and lactic, and the nature of the difficulty of forming exact conclusions may be thus shortly stated. The secretion contains, as already mentioned, alkaline chlorides, and supposing lactic acid to be also present, the fluid would, if distilled give hydrochloric acid, for the reason that slight elevations of temperature cause the decomposition of the chlorides by lactic acid. There are, however, two facts which lead very much to belief in the lactic acid theory. The first of these is, that Professor Graham has long since demonstrated by a process not involving the necessity for distillation that this acid is present in the normal condition of the fluid. The other is, that by a change occurring within the stomach itself, lactic acid is known to be produced. This circumstance I shall again have occasion to advert to.

Action of the Gastric Juice.—It was at one time supposed that the gastric secretion possessed the power of acting upon all the constituents of the food — that is to say, of acting equally on the nitrogenous, the starchy, and the oleaginous portions. This idea, however, has, since the researches of Frerichs and others with reference to the saliva, been abandoned, and it is now a generally accepted truth that the proper secretion of the digestive cavity dissolves only the azotised matters which are brought into contact with it. The amylaceous constituents of the food are by means of the saliva, with which the process of mastication impregnates them, converted into *glucose* — a substance which, as far as we are aware, requires no further preparation to be assimilated. The fatty matters are at the same time merely finely divided, and form a kind of emulsion with the chyme, undergoing digestion only after admixture with the biliary and pancreatic secretions. For the proper solution of the food in the gastric juice heat and motion are two essential conditions. If the temperature of the stomach be lowered digestion is much impaired; but then, on the other hand, if it be elevated above 120° the function is altogether checked. The action of gastric juice upon nitrogenised matter has often been carefully observed, not only in cases where the secretion has been obtained by fistulous openings into the stomachs of dogs, but, as in the well-known case of St. Martin, in the human subject. If a piece of coagulated albumen, for example, be suspended in a phial containing gastric juice, and the phial be placed in water which is kept at a temperature of 100° Fahr. after a short time the surface of the albumen becomes decomposed, and its edges become rounded. By slightly shaking the phial the pulpy matter which invests the mass is removed and dissolves in the fluid, exposing a fresh surface to its action, and if this be continued for a few hours the whole will be dissolved. Such a solution of albumen is very different in its constitution and properties to the solution obtained by dissolving albumen in a dilute acid, for while the gastric solution readily passes into the circulation, it has been demonstrated by Bernard that the latter is carried off with the urine. Attempts have been made to estimate the probable amount of the gastric fluid which is secreted in the twenty-four hours, from the assumption that a fixed quantity of the secretion is capable of digesting a certain weight of anhydrous fibrine or albumen. Not only must, in my opinion, such a mode of calculation be deemed fallacious, seeing that there is no evidence that the secretion of the dog, which has always been the subject of the experiments, resembles that of man with sufficient accuracy to admit of the deduction from one of facts which should apply to the other; but I find that the statements of different chemists as regards the solvent power itself differ so widely that we must cease to regard their results as even approximations to general truth. Thus, for instance, according to Lehmann, about twenty parts of the gastric juice of the dog are required for the digestion of one part of albumen. From these data the amount daily secreted by a healthy man must be from sixty to eighty ounces.[1] But if we are to believe Boudsult, who is one of those who have most recently experimented in this direction, 100 grammes of canine gastric juice will dissolve and digest forty grammes of dried fibrin — a widely different, and, I think, quite irreconcilable result.

Nature of Pepsin. — Pepsin, the organic constituent of the gastric juice, was first isolated and examined by Wasmann. He found that if the mucous membrane of a stomach were treated with cold water and the infusion evaporated to dryness, there remained a viscid, brownish

[1] *Stockhardt's Chemischer Ackerman*, 1860, No. 1. p. 51.

[1] It has been stated by Schröder to amount to a little more than 30 pints.—ED. CHEM. NEWS.

mass, having the odour of glue. The properties of a solution of this substance may be thus shortly stated.

It is precipitated by the addition of alcohol, tannin, or acetate of lead, forming in the latter case a compound of tolerably definite constitution—peptate of lead. It possesses the power of digesting nitrogenised substances if they are subjected to its action under fit conditions of heat and motion.

If the peptate of lead be decomposed by sulphide of hydrogen, a solution of pure pepsin is obtained.

This solution, which is neutral, is of itself incapable of effecting digestion, but if a small quantity of an acid, as lactic or hydrochloric, be added, solution proceeds rapidly. The pepsin seems, therefore, to *dispose* the acid to dissolve the substance, somewhat simulating, in fact, the action of a ferment. Indeed, the ferment theory would seem to be borne out by the action of pepsin upon grape sugar, which it converts into lactic acid. Here I must not omit to allude, in passing, to the manner in which the starchy portions of the food are digested. The action of the ptyalin in the saliva first converts the starch into grape sugar, which is capable of being assimilated without digestion, and by the further action of pepsin upon the grape sugar a sufficiency of lactic acid is produced to carry on the digestion of nitrogenised food. The changes which take place may be thus represented:—

One equivalent of starch $= C_{12}H_{11}O_{11}$ becomes
One equivalent of glucose $= C_{12}H_{12}O_{11}$ which is finally changed into
Two equivalents of lactic acid $= 2(C_6H_6O_6)$.

Artificial Pepsin. — The difficulty of conveniently obtaining the gastric juice of animals for medicinal purposes, and the disgust which many patients not unnaturally felt at its use soon led to its being altogether discarded, and it is only very recently that, under its new form, it has been reintroduced as a remedy. It occurred to M. Boudault that if he could separate the active constituent from the inert and useless substances associated with it in the gastric juice he would be able to produce not only a much less disagreeable medicine, but one of greater certainty of action. This he now effects in the following manner:—The stomachs of sheep are inverted and washed under a very gentle stream of cold water, and with a blunt knife the pepsin-secreting follicles are scraped off and beaten in a mortar with a small quantity of distilled water. The liquid filtered from this being next treated with a solution of acetate of lead, gives a copious white precipitate — peptate of lead — which is collected on a filter, and after being freed by washing from all excess of the lead salt is diffused through a small quantity of water. The suspended precipitate is next decomposed by a stream of sulphide of hydrogen, sulphide of lead and pepsin being produced. The former is separated by filtration, and the latter remains in solution. Now, if this solution of pepsin were simply to be evaporated to dryness, all due precaution not to exceed a temperature of 100° being observed, the product would be a gummy, very deliquescent mass, prone to decomposition, and altogether unfit for medicinal use. To obviate these inconveniences and give the pepsin a permanent form, M. Boudault mixes with the solution, when evaporated to the consistence of a thick syrup, starch powder in certain fixed proportions. This constitutes the "neutral pepsin" recommended by the inventor in cases where dyspepsia is complicated with abnormal acidity of the stomach. But for cases where there is no undue acidity a pepsin powder is prepared, to which *lactic acid* is added in such proportion as will give the degree of acidity which canine gastric juice is found to possess. There are also combinations of pepsin with morphia, strychnia, and iron; *olla podrida*, which I cannot but look upon as being not only unchemical, but calculated to lead to false deductions as to the value of pepsin itself.

Pepsin should be taken between thin slices of bread, not either before or after, but—in imitation of the natural secretion—*at* a meal. As any excess of temperature beyond 120° Fahr. totally destroys its digestive property, hot fluids should never be taken either immediately before or after its exhibition, and as it is decomposed by alcohol, if spirituous liquids be used at all they should be very much diluted.

In giving this outline of the action and chemical properties of pepsin with reference to the artificial preparation now found in commerce, I defer, in the absence of absolute proof to the contrary, to the statements of those physicians who have found its action beneficial, but at the same time cannot easily understand how such marked effects can be produced by the ingestion of so small doses of a substance which is secreted even in morbid conditions of the stomach in very large quantities. To take, for example, M. Boudault's own statement, that fifteen grains of his pepsin, which is usually taken as the type of what the preparation should be, is capable of digesting sixty grains of dry fibrin. This simply amounts to saying that this quantity—the ordinary dose of the remedy —will digest 400 grains, or somewhat less than an ounce of beef muscle, and this almost homœopathic addition to a deficient secretion is recommended in the face of the fact that were the whole quantity of gastric juice daily secreted by a healthy man expended upon the solution of bovine muscle, 14,000 grains, or 32 ounces, would be digested.

The pepsin; or *poudre nutrimentative* as it is called, of commerce, is a fawn-coloured powder, having somewhat the smell of glue, and in the ordinary lactic acid combination a sour taste.

The following tests for determining its purity have been given. The addition of a solution of acetate of lead should produce an abundant precipitate of peptate of lead; a similar addition of a solution of tannin should precipitate tannate of pepsin, and alcohol added in excess should throw down the pepsin itself. In addition to these, if we are desirous of estimating its real value, the *experimentum crucis* of testing its capability of digestion must never be neglected. For this purpose the pepsin is placed in distilled water at 60° Fahr. and the liquid filtered from the insoluble starch transferred to a small flask set in a water-bath, the temperature of which is maintained at 104° Fahr. The flask is closed with a cork, from which hangs a thread suspending a piece of coagulated white of egg or animal muscle. Matters being thus arranged the fluid should soon attack and disintegrate the mass. The first evidence of its action will be observed when the suspended matter becomes covered with a gelatinous layer which soon dissolves, exposing a new surface to the influence of the solvent. If the weight of nitrogenised matter acted upon bear to the quantity of pepsin in the liquid the proportion above indicated, complete solution should be effected in four hours. Agitation much promotes this result.

How far the pepsin powder now supplied will bear this practical kind of investigation may be judged from the following experiments, in which the preparations of two of the first manufacturers were employed. Fifty grains of each powder were weighed and respectively treated with an ounce of distilled water as above directed, and in the filtered solutions two slices of white of egg,

each weighing sixty grains, were suspended. A temperature never exceeding 104°, and never falling below 100° Fahr. was kept up for six hours with frequent agitation of the flasks. At the end of this time I found that in one of the flasks a slight solvent action had been exerted, rounding the edges of the albumen, and rendering its substance less tough and coherent. In the other no alteration whatever had taken place. I then repeated the experiment under precisely similar circumstances, but substituted for the solution of pepsin a like quantity of ordinary essence of rennet—an infusion of the stomach of the calf in salt and water—to which was added a few drops of hydrochloric acid. This rapidly disintegrated the albumen, and in three hours the whole was dissolved.

The only inference which I can deduce from these experiments is, that the two samples of pepsin were inert, and therefore absolutely without value, and as they fairly represent the bulk of the preparation which is at present supplied, much caution should be exercised in depending upon its effects. The digestive power of pepsin is so easily destroyed by inattention to the temperature at which its solution is evaporated, and its assay requiring much time and care to perform, I would suggest to any one anxious really to investigate the therapeutic value of this remedy the employment of en extemporaneously prepared fluid by maceration of a washed stomach in cold water as a substitute for the powder at present in use. In the mean time the manufacturers may see the advantage of preparing a powder which shall at least do that which it professes.[1] — *Dublin Medical Press.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On recent Researches in Physical Geography and Geology, by D. T. Ansted, *Esq. M.A. F.R.S.*

Lecture II. *Depths of the Atlantic.*

(*Concluded from page 46.*)

There is another diagram suspended representing a section across the Atlantic in much lower latitudes than the other. It is intended to mark the existence of that shallower portion of the sea which rises up near the equator, and which is not well seen though indicated in the other diagram to which I referred before. In order to give an idea of the relation of height which is exhibited in this way, I have also suspended a diagram or two which represent some of the mountain chains. Thus the section across the Andes will indicate to you the form of the land, constructed on the same scale as the diagram of the sea bottom, and this will show you that although the form is much more irregular than the telegraph plateau it is not more so than the sections taken across the Atlantic in other parts seem to indicate. There is no reason to suppose, therefore, that the Atlantic telegraph plateau extends universally, although it does appear that the depths of the Atlantic ascertained from point to point are upon the whole much more regular than might have been expected from most of the land in Europe and America. These points are sufficient to show in a general way the position and the form of the sea bottom and the circumstances connected with its form.

But we have said that it was desirable to determine something with regard to the temperature of deep water. This has been done by experiments most of them conducted independently of the observations for soundings. A long time ago it was known that in deep water in the open Atlantic the temperature diminished with increasing depth. Early observations at moderate depths showed that within the tropics there was not so much heat at a few fathoms depth as at the surface. Thus the temperature of the surface about 5° north of the equator is 83°, while at a moderate depth it sinks and continues sinking with the increasing depth until the water is extremely cold. When observations were made upon a larger scale in different parts of the ocean, it was found out that the temperature of the water diminished everywhere, and with a certain amount of regularity. At a depth of 500 fathoms in the tropics the temperature is constant at 57° Fah. and at 2500 fathoms it is reduced to 38°. The bottom of the water therefore is cold, and this seems to be the case all over the ocean floor. As far as the Atlantic telegraph is concerned this is a very important conclusion, as heat would affect the gutta percha covering. It was also of importance as proving that there are cold currents coming from the poles to the equator to correspond with the warm currants that are known to pass from the equator towards the poles. There is thus a certain circulation of waters in the ocean. With regard to deep currents their existence was almost disproved, at least to such an extent as to affect a sunk cable, by observations made in carrying down the deep-sea lead, and the way in which the results correspond with Massey's screw sounding machine, sent down at the same time with the other apparatus. This screw apparatus is constructed on the same principle as the patent log, which shows the quantity of water passed through by the number of revolutions made by a small wheel. The result of the observations of this kind was that there could be no rapid current in the deep parts of the Atlantic. A very remarkable instance of the accuracy of the apparatus was mentioned by Captain Dayman, in which about 1200 feet more line were out than seemed to belong to the depth as marked by the screw apparatus. On lifting the line this 1200 feet of length of line was found to be squeezed together and knotted up. It had, therefore, evidently not been drifted. The result of the soundings was also sufficient to show that in deep water there was no danger of icebergs.

With regard to the bottom, nothing could be known until the material was brought up, and even when brought up it required careful observation. The appearance of the material was pretty much the same in all cases, just such fine sand as I have in this bottle;—this is part of it. In one or two cases there was a portion of shell, and in one or two cases also a fragment of stone or mineral, but, in general, nothing but fine mud. Upon being dried, this material is found to be a soft white powdery mass, not very much unlike common whiting or chalk that has been ground up in water. When examined by the aid of the microscope, this is found to consist almost exclusively of the remains of organic beings. Over the whole of the plateau, and almost over the whole of the Atlantic, as far as it has been examined, and in other seas also, this result has been always obtained, and the mud is almost always nearly of the same kind, always containing the remains of organic beings. Some idea of these may be obtained by looking at the diagrams exhibited. The remains in question belong to a group of animals very simply organised, who appear to have inhabited deep water. At any rate, if they do not live there, their remains are so abundant as to form nine tenths, or even more, of the whole mass. When we consider that those minute animals, existing as they do in such abundance, in certain cases, near the surface of the sea, are also to be found, as it would seem, in the greatest depths of the ocean, it gives an idea of the prevalence of life in the water beyond anything one could imagine before hand. With regard to the nature of those animals, they are many of them, in the earliest stage, mere masses of jelly, or life without any apparent organisation. They are, however, able to throw out films or threads, or root-like filaments, from their bodies, and coat themselves with limestone or flint, and it is these little coatings of limestone or flint which are preserved. In a very short time a vast number of such animals are produced, each forming its own habita-

[1] The beneficial effects which have been ascribed to pepsin may perhaps be due to the lactic acid which it contains; all weak acids are known to act as stimulants to the digestive organs.

tion, and very often a number of different individuals of the same kind are connected together almost like a succession of bodies, coating each its own atom of carbonate of lime.

Many remarkable varieties of them were exhibited in diagrams, and the somewhat higher groups, such as salpæ, medusæ, pyrosomæ, and others, were also represented. Many of these are very common indeed at the surface of the water. The larger of these animals, often quite soft, feed on the small ones that have these cases, while the whales and large fish feed upon them again, so that there is a sort of succession of life. These larger animals dying and sinking to the bottom become the prey of the smaller ones, and so goes on the cycle continuously. There are also some of the vegetable, and some other animal forms, entirely coated with flint, so that there is a mixture of calcareous and flinty envelopes, but the calcareous matter is more abundant than the flint in the Atlantic. Through the kindness of Professor Huxley I am enabled to exhibit to you, through the microscope, a specimen of the mud obtained, which will show much more clearly than any description the extraordinary preponderance of one particular form represented in this diagram.

Let me now very briefly recall the chief points I have endeavoured to illustrate in this lecture.

A few years ago not the remotest idea could be entertained as to the bottom of the Atlantic, except that a very large proportion of it was more than 3000 or 4000 feet deep. Of the form of the bottom of that great canal, of the condition of the bottom, whether mud or rock, of its temperature, of the inhabitants, if such existed, no one could even guess. Large portions of all the deeper waters of the earth were regarded as unfathomable, and only by a kind of speculative possibility was it assumed that their depth bore about the same relation to their superficial extent that the elevations of the land bore to the surface of the land. But now what have we as the result of those successful investigations made by the deep-sea sounding apparatus:—The veil is lifted from the great valley of the Atlantic, and we see it descending by a succession of broad terraces and step-like cliffs to a deep central arena some 70,000 feet below the high ridges of the Andes and the Himalayas. On one principal upper floor of this grand amphitheatre, some ten or 15,000 feet below the sea level, between Ireland and Newfoundland, we have examined more carefully, and there we find across the whole 1800 miles one monotonous mud, at first sight most discouraging. What has become, we may ask, of those innumerable bones, and teeth, and scales, of the larger marine animals; those shells of molluscs and crustaceans that have died in the Atlantic? Where are the remains of the many ships that have been swallowed up by its waves? Where the substances drifted by the currents from distant shores? Nothing of these is to be found, but in their place this fine impalpable tenacious mud, looking like pounded chalk, and made up almost entirely of carbonate of lime. But what is this mud? How was it formed? How did it get to the bottom? What does it teach? The microscope reveals the history, or at least suggests it.

The step from the highest to the lowest organisation in the animals of the open ocean is but a short one. The main food of the gigantic whale is to be found either in the soft but complex poulpe or cuttle-fish or else in the hydrozoa — this latter group being far more simply organised but equally without solid framework. But these must feed on something, and some animals must feed on them. The ultimate atoms of life, the rhizopods, appear to occupy the terrace floors of that ocean whose surface swarms with salpæ, medusæ, and other hydrozoa. Down in those depths, which no surface animal reaches, where the pressure of the water amounts to some three tons on every square inch of surface, where each cubic foot of water probably occupies less space by 50 cubic inches than it would do if lifted to the surface, on this dark and gloomy plateau, where but few of the sun's rays can penetrate — there are these rhizopods, these simple yet marvellous structures, that not only assimilate food, but construct their compound habitations, each separating from the salt water its own atom of carbonate of lime and arranging it to form a covering for itself.

These, if any, are the inhabitants of deep water, and these flourish where all else of created life would fail to exist. Truly may we say that the secrets of the great deep, if mysterious, are also grand in their simplicity.

But below such depths are others compared with which these are as the plains of Tibet by the side of the mountain tops of the Himalayas. If all the mass of land forming the continent of Asia, with the gigantic turrets of the Himalayas themselves, were thrown into this deeper recess, there would still be blue water in that part of the Atlantic. What can we say of these dark recesses and how are they peopled? As yet, indeed, we are ignorant, but the time may soon come when of these also we may give an account. It is something merely to have opened out for investigation a subject so new, and it might seem so unpromising, and it is a noble result of scientific investigation to have thus surveyed the ocean floor and prepared it for that small twisted cable which already connects the two hemispheres. Even the short period of its temporary success, when the cable which now lies useless at the bottom flashed thoughts and words through the full breadth of ocean, even this is a glorious triumph, and cannot fail to be followed by a second effort that shall be more permanently successful.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

[From a Correspondent.]

THE meeting just concluded at Oxford, remarkable as it has been in many respects, will not, we imagine, be ranked as the most successful so far as the chemical section was concerned. To say the truth, our section is seldom the most brilliant of the meeting. The papers to be read are never too numerous, and the audience, though it may be fit, is always few. It is but seldom that a lady graces the section with her attendance. Occasionally one may look in at the door, but seeing a gentleman industriously chalking cabalistic formulæ on a black board, and catching a few such words as triethylphosphine and tetraphylammonium, she quickly disappears. It may be now and then that, hearing the organo-metallic radicals mentioned, she fancies them a peculiar currency school, and takes a seat with the hope of learning who represents that energetic party in the House of Commons, but being presently undeceived, she speedily departs, to section E perhaps, to hear Dr. Hincks discourse *on Ethnological Boulders*, or section A, to listen to Professor Pierce *On the Dynamic Condition of Saturn's Rings*, or some other equally interesting paper.

The first meeting of the section was held on Thursday.

President.—B. C. Brodie, Esq., M.A., F.R.S., Professor of Chemistry, Oxford.

Vice-Presidents.—Prof. Andrews, W. De la Rue, Prof. Faraday, Prof. Frankland, Prof. Hofmann, Prof. W. A. Miller, Dr. Lyon Playfair.

Secretaries.—G. D. Liveing, A. Vernon Harcourt, A. B. Northcote.

Committee.—Prof. Baumert, Prof. Beale, G. B. Buckton, Prof. Daubeny, Dr. Davy, Dr. Draper, G. C. Foster, A. Gages, J. P. Gassiot, Dr. Gilbert, Dr. Gladstone, W. R. Grove, Rev. W. Vernon Harcourt, Dr. Henry, Prof. Hochstetter, Dr. Matthiessen, Dr. H. Müller, T. J. Pearsall, Prof. Roscoe, Prof. Rowney, Dr. Russell, Dr. E. Smith, T. Spencer, Dr. Stenhouse, Prof. N. Story-Maskelyne, Dr. W. K. Sullivan, Prof. Voelcker, J. F. Way.

The PRESIDENT began his address by referring to the want of encouragement for the cultivation of the Natural Sciences in the University, which, whatever may have been its past shortcomings, has now, at all events, erected the most magnificent building in Europe, to be devoted to these sciences, and which has liberally endowed one or two pro-

fessorships. In due time, no doubt, when the clerical element in the University shall have become sufficiently reconciled, the substantial encouragement of some fellowships will follow, and Oxford will take its place as one of the first schools of natural science in England. In the meantime it must be confessed that a grand beginning has been made with the building of the new museum. But we must not altogether lose sight of Professor Brodie's address. He went on to review the principal events in the history of chemistry during the past year — the artificial formation of tartaric acid by Liebig — the conversion of succinic acid into the same body, by Messrs. Perkins and Duppa — the researches of Andrews on ozone, and many other things which make the year a rather remarkable one in the history of the science.

The Professor next alluded to the deficiency of scientific interest in the papers generally communicated to the chemical section of the British Association, and said that it was not the first announcement of new and brilliant discoveries that was expected, but rather suggestive papers on subjects of general interest likely to provoke useful discussion. In conclusion he remarked that the works on chemistry now in existence, although admirably adapted for students, were not exactly the books required by scientific men, and he suggested that the machinery of the British Association could be well applied to the compilation of a work which should include analyses of all known bodies.

The first communication made to the section was on a modification of Mohr's alkalimeter, by Mr. Symonds, a description of which would be scarcely intelligible without a drawing. The next was an ingenious and thoughtful paper by Mr. J. J. Coleman, *On some Remarkable Relations Existing between the Atomic Weights, Atomic Volumes and Properties of the Chemical Elements*. [We shall give a full report of this paper in an early number.] After this followed a communication which strongly illustrated the president's remarks on the lack of scientific interest in the papers. It was *On the Deodorisation of Sewage*, by Dr. Bird. The agent recommended by the Dr. as a deodoriser is sulphuric acid, which he drops into the sewage as it enters a series of sluices, and so forms "Sulphate of Sewage, or English Guano." After depositing the solid matter in the first sluice the liquid sewage passes on to another, and is mixed with alum and clay, and then to a third in which it is treated with lime. Each of the deposits so obtained the Dr. assures us is a powerful fertiliser. A short discussion followed in which Drs. Miller and Frankland and Mr. Spencer took part, but nothing new on the subject was elicited. All concurred in the impracticability of Dr. Bird's scheme, but no suggestion was made for the utilisation of sewage in any other way than by irrigation.

The Section then adjourned.

NOTICES OF BOOKS, PATENTS, &c.

Report to the New River Company on the Corrosion of Iron Mains, and the Effects of Gas Leakage on Metropolitan Street Earth, by Thomas Spencer, *F.C.S.*

Report on the Injurious Effects of Gas Leakage on the Street Earth, by H. Letheby, *M.B. M.A. Ph.D.* &c.

Everybody who has walked through one of the narrowest and most crowded thoroughfares of the metropolis at the busiest time of the day—Newgate-street, for instance, on a market morning—has most likely had an opportunity of examining the condition of the soil which underlies the London pavement, for, by some happy arrangement of the parties concerned, the streets are always taken up at the most inconvenient times. At such a time the observer must have been struck with the colour which the soil presented, as he is sure to have been sensible of the stench which it emitted. The colour is black, but it is not the blackness of mould or humus. It is a peculiar greyish black, which at once suggests to a chemist the presence of a compound of iron, sulphur, and carbon. The smell is so unmistakeably that of the impurities of gas that most people conclude the motive for taking up the street is the repair of a broken gas pipe. It may be so in some instances, but many will be surprised to learn that almost everywhere in the neighbourhood of gas mains the earth presents the same appearance and has the same disgusting smell, and that it is not owing to the escape of gas from broken pipes, but the result of ordinary leakage from defective joints. The extent to which this leakage takes place will astonish those not conversant with the facts. It is calculated by Mr. Wright to amount to not less than 386,000,000 of cubic feet per annum in the whole of the metropolis. In the City alone he estimates that 25,000,000 of cubic feet escape in the year, or nearly 70,000 cubic feet a day. But Mr. Spencer estimates it at nearly twice this amount. He says the total loss by leakage into the streets is about nine per cent. of all the gas distributed, or, in round numbers, 630,000,000 of cubic feet a year, which at the rate of eighteenpence a thousand, the cost price of gas, involves a loss to the gas companies of more than 47,000*l.* per annum. If that were all the loss sustained, and the mischief ended with the loss, it would excite but little regret, for nobody is much inclined to pity gas companies. But unfortunately others suffer as well. "In every way," says Dr. Letheby, "it is a nuisance, for it not only darkens the soil, and makes it so offensive that the emanations from it can hardly be endured, but it also impregnates the atmosphere of the sewers, and renders the basement rooms of houses unhabitable from the poisonous action of the gas, and even dangerous from explosion." But the most astonishing effects of the leakage remains to be told. It "is to convert the moisture in the earth into an acrid alkaline fluid," which rapidly corrodes the iron mains of the water companies, converting the iron into a soft plumbago-like substance that soon gives way to the pressure of the water. Before this happens, however, there is mischief done in another way. "Other circumstances," says Mr. Spencer, "have been pointed out to me, showing that the injury from gas escape is not confined to the exterior of water mains, but that the quality of their contents is often affected. When, for example, the supply is shut off, they are liable to become only partially full, from the draught on them at the other end. Under these circumstances the escaped gas penetrates their joints, and there mingles with the water. Hence complaints of the nauseous quality are not unfrequently made, which on examination are found to have their origin in this circumstance. Accidents have been occasioned from the same cause. On drawing water in the presence of a lighted candle, partial explosions are known to occur by the ignition of gas on opening the water tap."

We have not yet done with the ill effects:—"I may mention," says Mr. Spencer, "another general evil, of considerable magnitude, much of which has its origin in gas escape. This consists in the action of gaseous sulphur on silver, to say nothing of a similar action on other metals. Speaking practically, the value of silver, in the shape of plate, is less in the metropolitan atmosphere than in others where sulphur does not exist so abundantly. This will be evident on considering that every time plate is cleaned the coating of tarnish which has to be removed consists of 108 parts of silver to only 16 of sulphur, to say nothing of the extra silver removed in the operation. Moreover, if the vast increase of silver surface, since the introduction of electro-plate, is taken into account, and that, from the necessary purity of electro-silver, it combines more readily with sulphur (*i. e.* is easier tarnished) than ordinary silver, some idea may be formed of the vast annual waste of this metal in the metropolis alone. Many who have removed to London, from towns where gas is used quite as extensively, remark how much readier plate tarnishes here, though they have some difficulty in assigning the reason. Nor is this effect confined to houses where gas is used."

To the water companies the consequences are very serious. Iron pipes, when laid in the ground under ordinary conditions, will last at least a century, but in London streets they decay in about ten years. This decay, which takes place from without inwards, is not in the nature of ordinary rust, but is due to the action of sulphur on the iron. Mr. Spencer is of opinion that the sulphur is derived from two sources, the sulphuret of carbon in the gas and the gypsum in the soil. His experiments and observations show that the hydrocarbons of the gas decompose the sulphate of lime, and the sulphur thus set free, together with the ammonia and fœtid constituents of the gas, form with the moisture of the soil the acrid alkaline liquid before mentioned, which is the active agent in the corrosion of the pipes. This is no doubt the truth, and it is well that it has been pointed out.

Our space will not allow us to follow Mr. Spencer into his account of the effects of the sulphurous oxide of iron when carried into the Thames, but we must give the remedy he prescribes for the mischief we have detailed. This, in the language of Dr. Letheby, is two fold:—"First, the supply of gas freer from ammonia and sulphur compounds, and, secondly, the use of tighter joints. Already in some of the large towns of England, as in Liverpool, Manchester, and Leeds, the latter remedy has been applied. The ends of the pipes are turned and bored, and fitted into each other by grinding, like a stopper into a bottle, and thus the leakage from the joint has been prevented."

It is not too late, we should hope, to introduce a clause into the Metropolitan Gas Bill to compel the companies to use bored and turned joints in all the pipes they may lay down for the future, which it is quite clear, from the experience in towns mentioned above, would prevent most of the ill effects of which we complain.

Mr. Spencer deserves great credit for the skill with which he has worked out the subject, and for the able report which he has produced. In all his practical conclusions he is courageously supported by Dr. Letheby in the short report laid before the City Commissioners of Sewers. How long shall we have to wait for the remedy?

New Disinfectants.

John H. Johnson patents a communication from M. Silas and Pegot-Ogier, of Paris, for "Improvements in Destroying Noxious Exhalations." Provisional protection only.

The idea is to destroy noxious exhalations arising from stagnant water, or polluted streams or rivers, by employing "fire or inflammable mixtures, capable not only of burning in contact with water, but of having their effect considerably augmented by such contact. Would it be believed that the substances selected are such phosphurets as emit, when wetted, phosphuretted hydrogen, a substance which, in addition to its dangerous property of spontaneous inflammability, smells so intolerably that few English cesspools could dispute with it the palm of superior stinkship.

Dyeing with Orchil Colours on Cloths Mordanted with Lactarine. R. T. Pattison.

This process, which received provisional protection only, is merely for printing lactarine on the cloth, and subsequently dyeing with orchil colours.

Application of Hypochlorite of Alumina to Bleaching, Dyeing, &c.

Monsieur Zephirin Gaspard Alexandre Nathan Petrone Orioli, "utilises" hypochlorite of alumina, which he admits only exists in solution in water. He obtains it by mixing hypochlorite of lime and sulphate of alumina in equal quantities. M. Orioli's hypochlorite of alumina possesses, he says, the "inestimable advantage" over chlorine and acidified hypochlorite of lime of remaining entirely neutral during the whole time of the action. By this means he avoids any tendency in the fabrics, paper, pulp, &c. to turn brown or friable after bleaching. The alumina salt becomes entirely converted into chloride of aluminium during the decomposition of the colouring matters; advantage is taken of this fact, for the latter salt being powerfully antiseptic the pulp bleached by M. Orioli's process may be prepared in the winter and used the summer following.

M. Orioli applies his process to the preservation of anatomical preparations and the embalming of bodies. His claims are three, namely:—

1. Applying hypochlorite of alumina to the bleaching of paper pulps, thread, linen, and cotton cloths.
2. Applying hypochlorite of alumina as a mordant for printed calicoes and other printed cloths.
3. Applying hypochlorite of alumina to the disinfection of unhealthy localities, to the preservation of organic azotised matters, and also to the embalming of bodies, &c.

Ollivier's Patent for Closing or Stoppering Bottles, Jars, &c.

This invention consists in forming two holes, diametrically opposite to each other, in the neck of the bottle. The cork or stopper is then inserted, and a pin is pushed through two holes.

Paints and Pigments.

Benjamin Browne patents a communication from Francis Gybbon Spilsbury of Louvain, for improvements in the manufacture of paints and pigments. The processes given appear utterly vague and unmeaning.

In the first place, what pigments can be formed by heating sulphate of lead with alumina or other earths, with or without carbon or organic matter? It is true that metallic lead may by such a process be first formed by reduction, and then converted into litharge or minium subsequently, but that is evidently not the patentee's meaning:—"The pigments resulting from the above processes I wash, if necessary, first with sulphuric acid, then with water, and finally dry the same. I also digest the said pigaments (*sic*) previous to drying them, with salts of tungstic acid, molybdic acid, titanic acid, tantalic acid, arsenic acid, acids of antimony, or other metallic acid; or with mixtures of the above salts, whereby a combination between the sulphate of lead and the metallic acid or acids is obtained, and the resulting pigments I dry in like manner, after having washed them from all adhearing (*sic*) salt. Any of the dry pigments resulting from the above process may be mixed with oil or other vehicle, and used as a paint, after the manner of white lead, or any similar pigment."

It is too bad of the printers (to whom probably the blame attaches) to print such spelling. As provisional protection only was obtained, it was probably found that the processes were of no value.

CORRESPONDENCE.

Leigh's Process for the Purification of Coal Gas.

To the Editor of the Chemical News.

Sir,—Having become a reader of your most valuable work but a few weeks since, I find in No. 8 a process patented by John Leigh, for purification of coal gas. I beg leave to inform you that the process named by him has been successfully carried out here (at the Royal Arsenal Gas Works, Woolwich), and has been in use these last two years and eight months. If you think proper to advertise this for John Leigh's information, or any other, you are at perfect liberty to do so.—I am, &c.

John Wallace,
Manager of the Royal Arsenal Gas Works.

Is Hydrochloric Acid a Cure for Consumption?

To the Editor of the Chemical News.

Sir,—When I was engaged in the manufacture of alkali I had two establishments, one by the shipping place at a small seaport in Northumberland, the other about two miles up a shallow tidal river.

At this upper work, situated at a distance from any habitation, sulphuric acid was formed and salt decomposed, the muriatic or hydrochloric acid being allowed to escape into the atmosphere. The sulphate of soda was then removed by a barge down to the lower works, where it was converted into soda alkali.

The foreman at this lower work had a lodger, a young man, by trade a ship carpenter, who was very ill and much reduced, evidently in a consumption.

One fine warm day he asked leave to go up in the barge to the upper work, where he remained while the barge was being loaded, all the time breathing an atmosphere highly charged with hydrochloric acid gas. He experienced great relief from this, and often repeated his visit. He regained his strength rapidly, so that he was soon able to walk up to the work, where he spent much time, so eventually I gave him employment there, and he became a strong robust workman.

It happened that one of the workmen had a son who served his apprenticeship to a tailor, and who came home in bad health with all the symptoms of consumption.

The father aware of the circumstances above named, pursued a similar course, with an equally beneficial result. I gave this young man employment, and he too became a strong robust workman.

I have mentioned these cases to various medical gentlemen, but could never draw from them a decided opinion.

These cases occurred more than thirty years ago, since which I have been impressed with the idea that occasionally inhaling for a time air charged with hydrochloric acid gas, would prove a cure for consumption.

Conceiving that the Chemical News is a proper medium for conveying such ideas as above to the more intelligent portions of the community, I take the liberty of forwarding this simple statement of facts, which you, Sir, may publish if you think it worthy of a place in the columns of the Chemical News.—I am, &c.

An Old Alkali Manufacturer.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Selenic Acid and some Seleniates. — Hauer suggests[1] an improvement on the process of Mitscherlich, for obtaining selenic acid, for which see Gmelin's *Handbook*, vol. ii. p. 240. He has found that the decomposition of seleniate of lead by means of sulphuretted hydrogen takes place very slowly, and he therefore proposes to add a solution of nitrate of lime to the mixture of the solution of seleniate and nitrate of soda, by which means a seleniate of lime is formed. This is boiled with water and oxalate of cadmium which effects a complete decomposition. The oxalate of lime is separated by filtration, and then sulphuretted hydrogen is passed through the solution of seleniate of cadmium, which is afterwards filtered and boiled to drive off the excess of HS. The author has prepared the following salts by dissolving the carbonates or hydrates of the bases in selenic acid:

Seleniate of Soda, $NaO.SeO_3 + 10\,Aq$. Large crystals like those of Glauber's salt.

Seleniate of Lime, $CaO.SeO_3 + 2\,Aq$. Needles like those of the corresponding sulphate of lime.

Seleniate of Nickel, $NiO.SeO_3 + 6\,Aq$. These crystals, which are similar to those of the corresponding sulphate, lose 4 atoms of water at 212°.

Seleniate of Nickel and Potassium, $KONiO.2SeO_3 + 6\,Aq$, is obtained by the spontaneous evaporation of a solution of the two salts. These crystals also lose 4 atoms of water at 212°. The analogous sulphate is not altered at the same temperature.

Seleniate of Cadmium, $CdO.SeO_3 + 2\,Aq$, differs both in the form of the crystals and in composition from the sulphate. The crystals lose one of water on being heated to 212°.

Compounds of Vanadic Acid.—Some of these salts have also been investigated by Hauer.[2] To obtain them the author prepares a *bivanadiate of ammonia*, by first calcining the impure vanadic compounds got from pitchblende and then extracting with boiling water. The residue is again calcined, fused with nitrate of potash, and again extracted with boiling water. The solutions are then mixed, concentrated by evaporation, and the vanadiate of ammonia is precipitated by adding an excess of hydrochlorate of ammonia. The vanadiate is transformed into the bivanadiate, and this salt is purified by repeated crystallisations from water containing acetic acid. To form other bivanadiates the author decomposes the binvanadiate of ammonia by chlorides of bases, and purifies the salt obtained by recrystallisation, which must be done very carefully at a low temperature. The following is the composition of the salts examined by the author:

Bivanadiate of Soda	$NaO.2VO_3 + 9HO$
,, Strontia	$SrO.2VO_3 + 9HO$
,, Lime	$CaO.2VO_3 + 9HO$
,, Magnesia	$MgO.2VO_3 + 8HO$
Baryta Salt	$3BaO.5VO_3 + 19HO$

The hydrate of vanadic acid is prepared by decomposing the hot solution of a bivanadiate with nitric acid. The precipitate so obtained resembles the hydrated oxide of iron: it always contains a small quantity of the base of the bivanadiate employed, which may, however, be completely removed by repeated washing. Dried in the air the precipitate has the composition $2HO.VO_3$: over sulphuric acid it loses 1 atom of water, and there remains $HO.VO_3$.

The Colouring Principle of Stones and Rocks. M. Fournet complains[3] that when chemists analyse minerals they quietly put down *water and volatile matters* to account for the difference of weight after ignition, and sometimes a notable quantity figures as "loss." This arises from their having overlooked a common ingredient in rocks and flints which M. Fournet has rediscovered. The common idea is that metallic oxides give the colour to stones—and this is no doubt true of the greater number. Iron is the most common agent used. "When Nature," says Haüy, and Mr. Ruskin agrees with him, "takes up the brush, iron is almost always on the palette." However, M. Fournet finds in opals, chalcedony, common flints and other minerals of the same kind, some bituminous matter which gives to them their peculiar tint, and which must, he thinks, be classed with the mineral fats. The presence of this matter is shown by the empyreumatic smell produced when the stone is calcined, and the formation of other carbonaceous compounds, which are completely destroyed when the stone is very finely powdered and submitted to prolonged ignition. M. Bineau to show the porosity of minerals has kept them for a long time in various atmospheres. The vapour of iodine he finds communicates a very deep reddish brown colour, and so much of the vapours of alcohol and ether are absorbed as to enable the stone to give off for some time a strong smell of these bodies.

II. ORGANIC CHEMISTRY.

The Relations between Amyloid and Albumenoid Matters.— Our correspondent Mr. Sterry Hunt writes to the Academy of Sciences[4] to call attention to the fact that he was the first to point out the relations between the above bodies which M. Schoonbrodt has recently an-

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[1] *Sitzungsberichte der Akad. zu Wein*, Bd. xxxix. s. 299.

[2] *Ibid.* p. 488.

[3] *Comptes-Rendus*, l. t. p. 1175.

[4] *Ibid.* p. 1186.

nounced. The formula which Mr. Hunt proposed for protein, fibrin, &c. was the following:

$$C_{24}H_{17}N_3O_8 = C_{24}H_{20}O_{20} + 3NH_3 - 6H_2O_2$$

This formula, which represents fibrin as a *nitrile* of cellulose, requires for the percentage composition,

Carbon	53·9
Hydrogen	6·4
Nitrogen	15·7
Oxygen	24·0

These figures closely correspond with the analytical results, if we suppose that the small quantity of sulphur which the protein bodies contain replace an equivalent of oxygen. Fibrin Mr. Hunt regards then as *azoted* cellulose. Gelatine according to him is a nitrile of glucose.

$$C_{24}H_{20}N_4O_8 = C_{24}H_{24}O_{24} + 4NH_3 - 8H_2O_2$$

In support of this view Mr. Hunt quotes Gerhardt's experiment, which showed that gelatine by long boiling with sulphuric acid was converted into sulphate of ammonia and a fermentable sugar, and also insists on the fact that the albumenoid matters by the action of hydrochloric acid are changed into chloride of ammonium and a *humic* matter like that which results from the action of the same acid on sugar.

Oxide of Ethylene.—Wurtz[5] continues his researches on this body, and describes its reactions as follows:

I. It unites directly with acids and neutralises them.

II. In uniting with acids it is able to form basic salts.

III. The basic properties of oxide of ethylene are particularly shown by the action which it exercises on saline solutions.

When mixed with a concentrated solution of chloride of magnesium and left for some hours, the mixture solidfies, the magnesia is precipitated and the hydrochlorate of oxide of ethylene is formed. Potash decomposes this last body, and the oxide of ethylene is disengaged. Heated in a water-bath with perchloride of iron, it precipitates the hydrated sesquioxide. This experiment and some others which Wurtz mentions, show clearly that oxide of ethylene constitutes a true organic base, an alkaloid without nitrogen.

Vegetable Colouring Matters.—M. Filhol has published[6] some new researches on vegetable colouring matters. He has found that the colouring matters of different flowers exhibit different properties. Some flowers become blue when exposed to alkalies, while others become green. Some colouring matters too are more stable than others. The colour of the pelargonium zonale, for instance, will not change for some days in ammonia, while that of the violet bebecomes green immediately, and in a short time turns yellow.

M. Filhol at first thought there must be two distinct colouring matters in deep red flowers, but found that the differences disappeared when he operated upon pure cyanine instead of a liquid containing as well sugar as organic acids. M. Filhol has decided that cyanine does not contain nitrogen, and that it is identical with the colouring matter Glenard procured from wine, and which he named *œnocyanine*. The colouring matter of grapes is the same as that of blue flowers and the skin of radishes. A remarkable property of cyanine has been observed by Fremy and Cloez. They found that when red flowers were treated with alcohol they became bleached, but the alcohol was not coloured, only a faint colour being produced when a large quantity of flowers are used. Some red flowers have a colouring matter which is slightly soluble in water, and very soluble in alcohol; certain kinds of aloes for instance. This matter does not change under the influence of either acids or bases.

M. Filhol has discovered a new colouring matter in some yellow flowers. It is solid, amorphous, of a beautiful golden-yellow colour, soluble in water and alcohol, but insoluble in ether. It is distinguished from *xantheine* by its insolubility in ether, and by its not undergoing change when mixed with alkalies; and from xanthine by its solubility in water, and its apparent unalterability when mixed with hydrochloric acid, xanthine under the same circumstances becoming green. The new body possesses considerable tinctorial powers, and, like chlorophyll, will give a green, blue, or yellow colour. In studying the matters which accompany chlorophyll in plants, the author has discovered in the leaves of several *Conifers* a substance which, when acted on by alkalies, becomes of a beautiful rose colour, which is easily fixed on tissues. It is very rarely, it seems, that the various immediate principles which give the colours to flowers exist apart. Sometimes the same flower contains xanthogene, xanthine, xantheine and cyanine.

[5] *Comptes-Rendus*, l. t., p. 1195.

[6] *Ibid.* p. 1182.

MISCELLANEOUS.

The Liverpool Poisoning Case.—Thomas Winslow, charged with poisoning his late mistress (Mrs. James) with tartar emetic, was brought before Mr. T. S. Raffles, the Liverpool stipendiary magistrate, on Monday morning. The prosecuting solicitor (Mr. Walters) stated that since the previous Monday the case had assumed a much more serious character. In the bodies of Mrs. Townsend and her two sons, Samuel and William, which had been exhumed, poison had been found; and as it was intended to obtain the opinion and evidence of the most skilful analysts, it was desirable that the case should be adjourned until that day fortnight. The magistrate granted a remand in the meantime for seven days, the remand to be extended if found necessary.

Light without Heat.—Great heat without much light is produced by the combustion of hydrogen gas; and this fact has been successfully applied in the arts to the reduction of metals. Still, we think that if the case were reversed, and great light produced without much heat, a boundless field would be presented for its application to the most useful purposes. In deep mines, for example, when the danger arising from explosions by common lamps is most imminent, this cold light would at once revolutionise the whole art of mining. Such a light could be employed in powder magazines, the holds of ships, and also in warehouses and manufactories containing combustible materials. Light and heat are different in their nature, and science seems to have settled the question that, under certain circumstances, they may be separated; but, for practical purposes, artificial light without heat has not yet been applied. The fire-fly emits a soft and beautiful light, without its being apparently accompanied with equivalent heat. May not some mode be yet discovered for obtaining independent light without heat, and rendering it applicable to the purposes we have pointed out?

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

J. W. J. (Cardiff.)—Size the paper with a solution of isinglass, and, when dry, press it carefully with a warm, but not hot, iron.

Beta.—Aniline is sold by some manufacturing chemists. We do not know of a process for making it at a cheap rate.

Dr. Unger.—Write to Dr. Odling, or Dr. Redwood, Burlington House, Piccadilly.

Sub.—*J. D.*—*Oxygen*—*M. C.*—*Enquirer*—Received. Answers next week.

☞ Reading covers have been prepared for preserving the numbers of the Chemical News until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

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THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On some remarkable Relations existing between the Atomic Weights, Atomic Volumes, and Properties of the Chemical Elements, by J. J. COLEMAN, *Lecturer on Chemistry, and Director of the Laboratory, Commercial College, Making Place, Halifax.*[1]

1. NOTWITHSTANDING the numerous researches and calculations which have been made and brought forward respecting the atomic constitution of matter, it must be confessed that as yet we know little of the subject. It has been well said by a distinguished philosopher, "that the subject of the relation between atomic weight and density is not so far advanced as has been imagined;—that it is extremely difficult, considering the great number of causes of error, often inevitable, which beset such calculations, to attain that degree of exactness which apparently belongs to many of the results which have been put forth in connection with this subject. And what are the results so attained? Nothing more than a few numerical relations, difficult to connect together, and at present, unfortunately, of little theoretical or practical importance.

2. The object of the author on the present occasion is not the discussion of minute numerical relations, but to direct attention to a number of facts and relations of facts of a broad and general character, establishing some important generalisations, and which, as far as is ascertained, have not hitherto been dwelt upon, or brought before the notice of the scientific public.

3. As the term atomic volume will be frequently introduced in the succeeding remarks, it will be necessary to state the sense in which it is used. It is this,—"as indicating the space occupied or kept free from the access of other matter by the material atom itself, together with its investing sphere of heat."

4. The study of atomic volumes has occupied the attention of several distinguished men, Kopp, Schweder, and others on the continent; Playfair, Joule, and Herapath in England. Kopp and Schweder's numbers were arrived at by calculation, that is, by dividing the atomic weight of a body by its specific gravity, whilst our own countrymen, not satisfied with calculations, have gone to work experimentally, and determined for themselves the facts which they adopt as the basis of their subsequent calculations; yet the results arrived at by these independent researches, as respects the *atomic volumes of the elements*, correspond to a great extent, differing only in minor details.

5. In the third volume of Professor Miller's recently published elaborate *Elements of Chemistry*, is contained a very interesting summary of the most recent results arrived at as regards the atomic volumes of elements, and in the course of our remarks we shall frequently find it convenient to quote the numbers there given.

[1] Read at the Chemical Section of the British Association.

6. The first thing that strikes us as we glance over the table is that the atomic volumes of several elements correspond, so that they may be arranged in groups. This is a very curious fact, and one that was long since noticed. Thus we have the Mn, Fe, Co and Cu group; the Zn and H group; the Cl, Br and I group, &c.

7. We will first turn our attention to the group manganese, iron, cobalt, nickel, and copper, and notice certain chemical and physical characteristics appertaining to its individual members which appear to have an intimate connection with their respective atomic weights.

	Atom. weight.	Atom. volume.
Manganese	27·6	44 most active.
Iron	28·	44
Cobalt }	29·	44 intermediate.
Nickel }		
Copper	32·	44 least active.

Which of this series is most easily attacked by chemical agents? Manganese, and if we were to arrange them in the order of their susceptibility towards entering into combination (with oxygen for instance), we should have iron next to manganese, cobalt and nickel following in due order, and copper at the bottom of the list. Again, if their individual tendency to resume the metallic state, when in combination (as oxides, &c.), be studied, it will be noticed that Cu presents this property preeminently before the others; Ni and Co are not so easily reduced as Cu; iron not so easily as the last two; and manganese least readily of the whole. Turning for a moment to the consideration of their electrical relations, it will be remembered that manganese is the most electro-positive, and copper the most electro-negative. So here we have a group of elements having a common atomic volume, and possessing properties the manifestation of which appears to accumulate in proportion as the weight of the atom increases.

8. Leaving for the present any further consideration of this particular group, and directing attention to the metals zinc, rhodium, palladium, iridium and platinum, we shall find similar relations existing between the members of the group; but as the reactions, the physical properties of rhodium and iridium, are scarcely so well understood as those of the others, it will be well to confine our remarks at present to the consideration of zinc, palladium and platinum.

	Atom. weight.	Atom. volume.
Zinc	33	57 most active.
Palladium	53	57 intermediate.
Platinum	98	57 least active.

It is not necessary to dwell upon their relations, so marked is the character of their behaviour with chemical agents. We well know the eagerness, the avidity with which zinc enters into combination; and on the contrary, the remarkable fixity of platinum. The ease with which platinum may be reduced from its compounds, and as compared with this, the difficulties experienced in the reduction of zinc are facts familiar to every chemist. And between these extremes is the metal palladium,

standing midway, neither so intractable as the one, nor so ready to rush into combination as the other. And now, referring to their respective atomic weights, we find that the most intractable metal of the three possesses the greatest atomic weight; the most chemically active metal of the three the least atomic weight; the metal with intermediate properties an intermediate atomic weight. Thus the numerical difference existing between the weights of the atoms of the respective members of this group is represented in an equally marked manner by the relative properties of the three metals which constitute it.

9. Aluminium, chromium, molybdenum, tungsten, are the next group on our list.

	Atom. weight.	Atom. volume.
Aluminium	14	66
Chromium	27	66
Molybdenum	46	66
Tungsten	95	66

With regard to the three last, there exists between them certain analogies which ally them together as a well defined group, the members having many properties in common. To connect aluminium with them is not so easy, but a few marked relations existing between the whole can be made very evident. Of the four metals aluminium is without doubt the most difficult to reduce from its compounds, for we all well know that until recently it could not be produced in any available quantity. And having produced it, or rather isolated it, what are its qualities? We are apt to, and many do, imagine that aluminium should be classed with the noble metals, because of its powers of resisting ordinary atmospheric influences; but if we carefully consider the chemical qualities of aluminium, such a conclusion can scarcely be arrived at. Dilute acids, hydrochloric, for instance, alkaline solutions have no action on the noble metals, but they act upon aluminium violently. The noble metals, in whatever combination they may be, are easily isolated, reduced, but we cannot say that aluminium is easily reduced. Aluminium possesses, like carbon, a certain amount of fixity under ordinary atmospheric conditions, but the limit of its resistance is soon attained—the metal is violently attacked, disappears, and manifests no tendency towards the resumption of the the metallic state. This peculiar property enjoyed by aluminium is possessed by other elements, having a similar atomic constitution, as will be seen when we again refer to the subject in an after part of our investigations.

Dismissing for the present any further consideration of aluminium, let us consider the relations existing between chromium, molybdenum and tungsten. A moment's consideration will convince us that of the three chromium is the most active. This is manifested by the numerous well defined chemical compounds which it forms, the representatives of which we cannot find in the molybdenum and tungsten series; for instance, we have the compounds it forms with oxygen—one basic, one neutral, two acid. Molybdenum, with the same agent, only forms three—a very feebly basic, a neutral, and an acid compound. Whilst tungsten is only capable of forming two—a neutral and acid compound. Again, comparing the character of the acids we have mentioned, chromic acid is well defined, is a powerful acid, forms stable compounds; whilst tungstic acid is characterised by its inactivity, its insolubility, the indistinctness, the badly defined character of the compounds it forms with bases; and molybdic acid is intermediate between the two, neither so active as chromic acid, nor so inactive as tungstic acid.

Returning to the metals themselves, and considering their relative reducibility, we shall notice that agents, (hydrogen, for instance), which easily reduce the metals from the tungstic and molybdic compounds, have no such effect on the chromic compounds. It is not so easy to compare the relative reducibility of molybdenum and tungsten; still a thorough examination of the subject will convince us of the fact that tungsten is more reducible than molybdenum. Thus we are brought to the same point that we arrived at in reviewing the former groups—*we find that with this series of elements having a common atomic volume, the manifestation of certain properties accumulates as the weight of the atoms increases.*

10. Passing on we notice that selenium and sulphur have equal atomic volumes, but their atomic weights differ widely.

	Atom. weight.	Atom. volume.
Sulphur	16	101
Selenium	40	101

This group affords an excellent instance of the relations which we are seeking to establish. The weight of the sulphur atom is 16, that of the selenium atom 40, or 2½ times as much. If the element, then, possessing the least atomic weight is invariably the most active, sulphur ought to have greater affinities, more tendency to enter into combination than selenium. We do not require to seek long for a proof that such is the case; one fact, an experimental fact, will suffice, it is this: upon passing a current of sulphurous acid through a solution of selenious acid, the sulphurous acid is converted into sulphuric acid, and selenium is isolated, deposited.

Before leaving this series we will notice the connection it has with another element on the list, endowed with properties very analogous to those of sulphur and selenium—that is tellurium. The atomic volume of tellurium is certainly larger than that of the other two, but not to such an extent as to prevent our making comparisons. Now tellurium, as regards its properties, stands in relation to selenium as selenium stands in relation to sulphur. Thus tellurium is more easily reduced than selenium; it is less active than selenium; its oxides are more neutral than those of selenium; and connected with these peculiarities, these leading points, we notice that the weight of the tellurium atom is 64, whilst that of the selenium atom is 40.

11. Leaving for the present arsenic and tin, two metals between which a fair comparison can scarcely be made, the next group arrived at is lead, gold, silver.

	Atom. weight.	Atom. volume.
Lead	103·7	114
Silver	108·0	128
Gold	197·0	128

Although these three metals are connected together, it will be noticed that the atomic volume of lead is rather less than the volumes of the other two; but, on the contrary, we observe that the weight of the silver atom exceeds that of the lead atom. In considering the chemical activity and reducibility of the two as compared together, we cannot but come to the conclusion that lead is the more active, the more difficult to reduce of the two. As to the reducibility, the distinctions are very marked. Who would maintain that chloride of lead is more reducible than chloride of silver? Or nitrate of lead than nitrate of silver? But still there is a certain similiarity existing between the two metals as respects the amount of force associated with their respective atoms; for instance, each require two atoms of oxygen to form PbO_2 and AgO_2 respectively, two very analogous and characteristic compounds, Each

forms insoluble compounds with chlorine; each resists the action of dilute sulphuric acid; each forms insoluble compounds with that acid; and numerous other analogies exist which it will be unnecessary to mention. The point to which we are brought is this: that the weight of the silver atom being greater than that of the lead atom, silver is more easily reduced than lead, and that the slight difference existing between the metals with regard to their behaviour towards reagents, finds its exact representative in the equally slight differences existing between the weight of their respective atoms. But when we come to compare gold and silver in a similar manner the relations are much more striking: that silver is more chemically active than gold, that gold is more reducible than silver, we cannot for a moment dispute. Thus we arrive at another beautiful illustration of the relations which we are seeking to establish. The gold atom has double the weight of the silver atom, hence its inactivity, its indisposition to enter into or remain in combination as compared with silver.

12. Phosphorus and antimony are the next elements we will group together. Bismuth may be included, as its atomic volume does not differ much from that of the other two.

	Atom. weight.	Atom. volume.
Phosphorus	32	211
Antimony	129	224
Bismuth	213	270

In this group the element endowed with the most powerful affinities, the greatest activity, is undoubtedly phosphorus; and connected with this activity, this eagerness towards entering into combination, we notice that the atomic weight of phosphorus is less, considersiderably less, than that of any other member of the group. The element in the series endowed with the greatest atomic weight is bismuth. That bismuth is more inactive than phosphorus is self-evident, and a little examination will convince us that bismuth is also more inactive than antimony.

The antimony compounds are more extensive, more active, better defined than those of bismuth. The antimony compounds are more difficult to reduce than those of bismuth; and thus we arrive at the same result as before. The atom possessing the greatest weight in a group of elements with a common atomic volume is endowed with the least chemical activity, the least tendency towards entering into combination.

13. And now we arrive at a peculiarly interesting triad—chlorine, bromine and iodine.

	Atom. weight.	Atom. volume.
Chlorine	35·5	320 (liquid.)
Bromine	80	320
Iodine	127	320

The beautiful numerical relations existing between the atomic weights of these elements, which were noticed some time ago by Dumas, cannot but be regarded with great interest; but when we are led to suspect that those numbers represent a force associated with the atom —that chlorine possesses a force represented by 35·5, the weight of the atom; that bromine has a quantity of the same force represented by 80, the weight of its atom; that iodine has a quantity of the same force represented by 127, the weight of its atom, the whole subject becomes of intense interest. That there is such a relation existing is evident. Chlorine, the most active of the three, endowed with the widest range of affinities, we find possesses the least atomic weight; whilst iodine, having the greatest atomic weight, is impeded and constrained in its movements, manifesting little tendency towards entering into or remaining in combination; and bromine, with an atomic weight greater than that of chlorine, but less than that of iodine, is intermediate between the two as respects the amount of force, the activity with which it is endowed.

(To be continued.)

TECHNICAL CHEMISTRY.

The Thames as it was, is, and may be.[1]

In the spring quarters of the last two years I have had to report to you of the putrid condition of the river, and to discuss the circumstances which have attended it; but this year I am relieved from that necessity, for up to the present time the river has not been offensive. In point of fact, it would appear from the analyses which I have lately made of the water, and a comparison of them with the results obtained by Dr. Lambe and Dr. Bostock in 1828, that the river is now in its normal condition. At that time the water of the Thames at high tide at Lambeth and Blackfriars contained only about 27 grains of dissolved matter in the gallon, which is not much above the natural proportion of its constituents at from Teddington Lock to Wandsworth; and during the whole of the present year this has been nearly the proportion found in the water at high tide at London Bridge. Last month the highest proportion was 32 grains in the gallon, but at all other times of this year it has ranged from 24 grains to 27 grains in the gallon; and of these from 2 to 4 grains only were organic. Last year, however, at this time the water contained 94 grains of soluble matter in the gallon, and the year before it contained nearly 144 grains, of which from 11 to 12 were organic; but little by little the proportion went on iccreasing until in August and September it amounted to from 300 to 400 grains in the gallon, and during the whole of that time the river was most offensive. The sources of these impurities I have already described — they were derived from the sea-water and the stagnant sewers.

The present state of the river has evidently been secured by the continuance of wet weather. In the month of May of last year the total rain-fall in London was but two inches — whereas in the corresponding month of this year it has amounted to 3·7 inches. In June of last year it was barely 2 inches, and of the year before only 1·2, but in the three weeks of the present month it has been 4·6 inches. The wet days have also been more numerous, and therefore the supply of fresh water to the Thames more continuous. This is the principal circumstance which has characterised the present season, and it has manifestly been the principal agent in securing the normal condition of the river, for the effects of temperature on the water up to the present time have not been so marked to have exerted any important influence. At this time last year and the year before the Thames was very offensive, notwithstanding that the mean temperature of the water during the month of May was nearly a degree lower than it has been during the same month of the present year. The conclusions, therefore, to be deduced from these facts are, that the main causes of the putridity of the river are a great excess of sea-water far up in the stream, and a large amount of organic matter from the stagnant sewers, both of which are due to a continued absence of rain, and to the sudden flushings of the sewers during the upward flow of the tide.

[1] From the Quarterly Report of Dr. Letheby to the City Commissioners of Sewers.

A certain temperature is, of course, necessary to the putrefactive changes, for they do not progress with any remarkable activity below the temperature of 60°, but when the heat of the water rises, as it did in June, July, and August of last year, to a mean temperature of 72°, the changes are exceedingly rapid; and then also the mischief is greatly increased by the decomposition of the mud upon the exposed banks of the river.

Dr. McWilliam, of Her Majesty's Customs, has so recently inquired into the effects of the river miasms, and has so clearly shown that they have not yet produced the injury which was anticipated of them, that I need not here discuss this subject. Happily for us there is evidently some condition wanted to make "this filthy river capable of generating cholera, or of forming a soil fit for the germination of the seeds of that disorder when introduced into it." But this is no argument for the neglect of sanitory precautions, or for disregarding every means for abating the noisome condition of the water. Nor is it a reason for temporising with the mischief, by resorting to any doubtful expedient that may merely serve as a costly disguise for the nuisance. Already I have reported on this matter, and have directed your attention to the uncertainty of the proposed plan for deodorising the river by means of perchloride of iron. Since then, however, I have ascertained that the perchloride is highly charged with a compound of arsenic, which is exceedingly poisonous. A sample of the liquid, furnished to me by the patentee, Mr. Dales, and described by him as the same as that used in the experimental inquiries for the Board of Works, has yielded from 296 to 297 grains of chloride of arsenic per gallon. If, therefore, the sewage of London were deodorised in the way proposed, there would be discharged daily into the Thames as much as 227 pounds of chloride of arsenic. I cannot tell you what would be the consequences of this, but it would be equivalent to the casting into the river about one hundred weight and a half of powdered arsenic daily. It is true that the poison would be diluted with a large quantity of water, and with many millions of gallons of sewage, but a knowledge of this fact would afford no relief to our apprehension of danger, or to the anxiety which must be felt, lest the accumulated effects of the poison might soon be dangerous in the extreme.

PHARMACY, TOXICOLOGY, &c.

On Radix Taraxaci, by J. Schweitzer.

However much there has been said about Radix Taraxaci, we are far from possessing an unanimous opinion as to the proper time for its collection, and while practical men continue to use the autumnal root, theoretical professors will persist in declaring the spring as far more suitable. Everybody agrees, however, as to the great difference in the root during the four seasons. The amount and quality of the extract made at the commencement of summer is far inferior in quantity and quality to that made from the fresh root in October, and it may be as well to consider the reason for this more than ordinary difference.

A root must bear a certain and naturally inverse relation to stem and leaf. Summer is the season for flowers and herbage. When they wither, the root, the sole representative of the plant, commences to flourish and to collect store to enable it to pass successfully through its long wintry sleep; and in the spring, the root, which was strong and juicy in autumn, is shrivelled and poor in vegetable extractive, but exceedingly rich in earthy salts, especially phosphates, to build under the influence of light and warmth, in surprisingly short time, a firm and solid stem for flower and leaf.

Each plant possesses the property or power of extracting from the soil peculiar and specific principles which medicine has taught us to use for the maintenance or restoration of health, and we prepare accordingly organic salts, vegetable acids and alkaloids, volatile oils, or soluble vegetable extracts.

For the preparation of these different principles we have to collect the vegetables at one particular and most suitable period. If we wish to prepare a soluble extract we naturally collect the plant, or that part of it which is used, when it is richest in vegetable juice; and experience teaches us that with Radix Taraxaci, as with most other roots, this is autumn. Should we desire however the earthy phosphates by preference, we would do better to select the drier root of spring.

Very frequently these vegetable juices are easily decomposed by heat and exposure to air, and to preserve the original properties of the plant when the juices are inspissated requires some particular care and precaution. This speedy and spontaneous decomposition is very apt to take place in the sap expressed from the root of the dandelion, and this, with the great difference in the root itself, sufficiently accounts for all the different but professedly identical preparations of this plant we meet with.

To obtain a uniform strongly active Extractum Taraxaci, the root ought always to be collected at the same time of the year, viz. autumn. The fresh and well washed root is crushed, pressed, and the expressed and strained juice quickly evaporated at a low temperature. This can only be done in a long shallow pan, by means of a current of dry air, which is to be continually forced over it. This will yield a beautiful greenish extract, which maintains its consistence and activity for any length of time, while an extract prepared over a water bath will be of a dark brown colour, sometimes almost as tenacious as bird lime, or so rich in saccharine matter as to be a wholly new product, representing anything rather than the innocent dandelion. Both these new qualities are the consequences of the formation of new products by the spontaneous decomposition of the juice itself, neither the pectic acid, to which the tenacity is owing, nor the saccharine matter existing originally in the juice.

The whitish fluid Extract of Taraxacum is prepared in a similar way, but in order to succeed well with this extract the root must be scrupulously clean, and all the operations of crushing, pressing, evaporating, &c. must be performed in vessels not made of iron. The inspissation need not be carried to the same extent, and when cold this extract is to be mixed with 15 per cent. of alcohol.

The bright sherry-coloured liquor is prepared by mixing the same fresh juice with 15 per cent. of alcohol, allowing it to stand for two or three weeks, and then filtering. Should it not possess the desired brightness, it will be necessary to fine it with a little isinglass, when a beautiful permanently bright liquor Taraxaci will be obtained.

143 New Bond Street.

Notes on some of the Chemical Reactions of Brucia, by T. G. Wormley, *M.D.*

In the following experiments pure crystallised brucia was dissolved in pure water, when necessary, by the aid of just sufficient acetic acid. No deduction was made for the water of crystallisation in the alkaloid. A small drop of a saturated solution of the reagent was applied to a grain of the brucia solution, placed on a glass slide.

The amount of brucia operated upon will frequently be stated in the form of a fraction, it being understood to imply the fractional part of a grain of brucia, in one grain of water.

I. Potash.—1. $\frac{1}{100}$th grain of brucia gives, with a solution of potash, an immediate white amorphous precipitate, which very soon becomes a crystalline mass. The ppt. is readily soluble in acetic acid, and in deficiency of the reagent, but not readily soluble in large excess.

2. $\frac{1}{500}$th, gives an immediate cloudiness, which is soon crystalline, but not abundant. The ppt. is increased by rubbing the drop with a glass rod.

II. Ammonia.—1. $\frac{1}{100}$th, gives no immediate ppt., but very soon crystals begin to form, which in a few minutes are very abundant. If the solution be rubbed, granules and crystals appear immediately. The ppt. is prevented by large excess of ammonia, but when formed it is not readily dissolved by excess.

2. $\frac{1}{100}$th, by rubbing a few minutes, granules and crystals appear.

III. Sulphocyanide of Potassium.—1. $\frac{1}{100}$th, in a few seconds crystalline tufts begin to form, which are not readily soluble in acetic acid.

2. $\frac{1}{500}$th, no indication after 15 minutes.

IV. Iodide of Potassium.—1. $\frac{1}{100}$th, almost immediately rough crystals begin to form, and in a short time there is a good deposit of tabular plates.

2. $\frac{1}{500}$th, no indication after rubbing several minutes.

V. Chromate of Potash.—1. $\frac{1}{100}$th, gives an immediate yellow amorphous ppt. which very soon becomes groups of aciculated crystals, insoluble in acetic acid.

2. $\frac{1}{1000}$th, by rubbing a few minutes there is a very good crystalline ppt. If excess of the reagent is used, there will be no ppt.

3. $\frac{1}{2000}$th, after rubbing several minutes there will be a slight amorphous cloudiness, but no crystals.

VI. Bichromate of Potash.—1. $\frac{1}{100}$th, same as with chromate of potash.

2. $\frac{1}{1000}$th, by rubbing, immediate rings of crystals.

3. $\frac{1}{1000}$, in several minutes a distinct amorphous ppt. which after some time becomes crystalline needles.

VII. Tannic Acid.—1. $\frac{1}{100}$th, an immediate copious dirty white amorphous ppt. which is soluble in a few drops of acetic acid.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{10000}$th, immediately obvious; in a few minutes it is very satisfactory. The ppt. is somewhat bluish.

4. $\frac{1}{20000}$th, in a few seconds a bluish ppt. is obvious, which soon becomes quite good.

5. $\frac{1}{40000}$th, in a little time the ppt. is perceptible.

VIII. Carbazotic Acid.—1. $\frac{1}{100}$th, gives an immediate copious greenish yellow amorphous ppt. which after standing some time becomes crystalline. The ppt. is not easily dissolved by large excess of acetic acid.

2. $\frac{1}{1000}$th, an immediate yellowish green amorphous ppt.

3. $\frac{1}{5000}$th, in a few seconds a green ppt. which is increased by rubbing.

4. $\frac{1}{10000}$th, after several minutes the ppt. is just perceptible.

IX. Terchloride of Gold.—1. $\frac{1}{100}$th, an immediate yellow amorphous ppt. which soon becomes flesh coloured.

2. $\frac{1}{1000}$th, a greenish yellow ppt. soon becomes yellow; upon the addition of a few drops of a potash solution the ppt. dissolves and gives a clear solution, with a slight dark ppt.

3. $\frac{1}{10000}$th, much the same as 2.

4. $\frac{1}{20000}$th, the ppt. begins in less than a minute, and soon is quite satisfactory.

5. $\frac{1}{40000}$th, the ppt. is obvious, but not satisfactory after several minutes. All the above precipitates remain amorphous.

X. Bichloride of Platinum.—1. $\frac{1}{100}$th, gives a light yellow amorphous ppt. which almost immediately becomes small aciculated crystals; in this it differs from strychnia. The ppt. is insoluble in acetic acid.

2. $\frac{1}{1000}$th, an immediate crystalline ppt.

3. $\frac{1}{5000}$th, very soon crystals appear; they are increased by rubbing.

4. $\frac{1}{10000}$th, by rubbing, crystalline rings are immediately produced.

5. $\frac{1}{20000}$th, in a few minutes prismatic crystals are seen; with the microscope they are rather abundant.

6. $\frac{1}{40000}$th, not satisfactory after several minutes.

Chloride of palladium gives the same results as the above reagent.

XI. Ferricyanide of Potassium.—1. $\frac{1}{100}$th, gives an immediate light yellow amorphous ppt. which soon becomes beautiful rosettes, plates, and stella. These are the most beautiful polariscope objects that we have seen, often showing colours without either polariser or analyser. These crystals are very characteristic.

2. $\frac{1}{500}$th, by rubbing, very soon an abundant granular ppt.

3. $\frac{1}{1000}$th, after some time, a slight cloudiness.

Ferrocyanide of potassium gives no ppt. in a $\frac{1}{100}$ solution.

XII. Bromine in Bromohydric Acid.—1. $\frac{1}{100}$th, copious brown amorphous ppt. which soon changes to yellow, and will dissolve if sufficient reagent has not been added. Soluble in excess of acetic acid and potash.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{10000}$th, a greenish yellow amorphous ppt. which after a little time dissolves, and is not reprecipitated upon the addition of reagent.

4. $\frac{1}{20000}$th, greenish yellow, soon dissolves.

XIII. Iodine in Iodide of Potassium.—1. $\frac{1}{100}$th, copious orange-brown amorphous ppt. insoluble in acetic acid, but dissolves in several drops of potash solution, with the production of a dirty white ppt.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{10000}$th, brownish ppt. soluble in a drop of potash solution, without the production of a white ppt.

4. $\frac{1}{50000}$th, a greenish yellow ppt.

5. $\frac{1}{100000}$th, a very distinct, dirty yellow cloudiness. It is best observed by placing a drop of the reagent by the side of the brucia solution, and allowing the drops to flow together.

6. $\frac{1}{500000}$th, the cloudiness is still perceptible.

XIV. Sulphuric Acid and Nitrate of Potash.—1. $\frac{1}{100}$th, if the drop of brucia solution be evaporated to dryness in a steam bath, and the residue be touched with a small drop of concentrated sulphuric acid, it will immediately become rose red, and give a solution of much the same colour; if now a small crystal of nitrate of potash be added, the solution immediately changes to a fine orange red.

2. $\frac{1}{1000}$th, upon the application of sulphuric acid, the residue becomes a very fair rose red, but the solution is faint; the addition of the nitre gives a fine orange.

3. $\frac{1}{10000}$th, the acid gives a faint red, and the nitre an orange, which soon becomes yellow.

4. $\frac{1}{20000}$th, the acid solution has a faint red colour, which is best seen over white paper; the addition of nitre changes it to yellow. If a small crystal of nitre be moistened with sulphuric acid, and then dragged over the deposit, the crystal becomes orange, and gives a solution of the same colour.

5. $\frac{1}{40000}$th, if the nitre, moistened by the acid, be placed upon the deposit, the crystal immediately becomes quite red, and when pushed over the deposit leaves a red track.

We may thus, by the above means, apply two very characteristic tests to the same deposit.

XV. Nitric Acid and Chloride of Tin.—1. $\frac{1}{100}$th grain pure brucia, if touched with a small drop of nitric acid, becomes a fine bright red, and gives a solution of the same colour, which upon the application of heat is changed to yellow red; if, after the solution has become cold, a drop or two of solution of chloride of tin be added, it immediately assumes a beautiful purple. The colour is destroyed by excess of nitric acid.

2. $\frac{1}{1000}$th, the acid gives a fine red, which soon becomes yellow red, and, when heated, is changed to yellow. The tin solution gives a beautiful lilac colour.

3. $\frac{1}{10000}$th, with the deposit, the acid gives a very good red, and the solution is faintly red; if, after heating, the proper quantity of tin solution be added, it gives a perceptible lilac, but it is necessary that the quantities of acid and tin be well apportioned, otherwise the latter will give no indications. This is about its limit.

4. $\frac{1}{20000}$th, if the brucia solution be evaporated to dryness in a watch glass, and while warm, a very small drop of nitric acid be placed in the centre of the deposit, the margin will soon become perceptibly red; if then the deposit be dissolved in the acid, and evaporated to dryness in a steam oven, it will leave a good red ring deposit.

5. $\frac{1}{40000}$th, when treated as in 4 the acid gives but little indication, but when it is evaporated it gives a very fair red ring.

6. $\frac{1}{100000}$th, the acid gives no indication, but when evaporated it leaves a deposit in the form of delicate red threads, which are best seen by placing them over a white surface.

As an appendix to the *colour test*, in the article Strychnia, in Vol. I. pp. 219, 242, of this journal. If $\frac{1}{100000}$th grain of strychnia be treated with a very small quantity of concentrated sulphuric acid, and the amount of bichromate of potash be well adjusted, it will give perfectly satisfactory results; the deposit containing very many visible points, any of which would be characteristic. These results were obtained from the deposits of several different solutions of strychnia. It is but right to state that, to be successful, it requires a very nice balancing of the materials concerned.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Product Collection in the Museum, by Ed. Lankester, *M.D. F.R.S.*

Lecture V. *On Soap and Candles.*

We have spoken of the hairs, skins, and skeletons of animals, and now I shall draw your attention to the fact that between the skeleton and the skin there are a number of organs collecting materials which are of great value to man.

The particular substance I wish to draw your attention to is that the absence of which we notice when we speak of a man as nothing but skin and bone. When he is something more we speak of him as being well fed, and according to the quantity of material—fat. No animal exists without this substance to a greater or less extent, and never when it exists is it useless. Although we throw away a great quantity of animal matter as refuse all of it is useful. To give you one illustration, I may mention that some three or four years ago a decree went forth in Paris that all dogs that had no owners should be shot and thrown into the Seine. And there they were in thousands and tens of thousands. But the chiffonniers of Paris found out that the dogs had fat, which they collected and boiled down, and it turned out to be a very valuable speculation. I shall endeavour to impress you with the necessity of a knowledge of the fact that there is nothing in an animal that may not be made use of.

Now let us look at this adipose tissue. We find it existing in various parts of the animal body, and when we take a portion of the fat of any animal and examine it under a microscope we see a quantity of cells called fat cells, which lie amidst the cellular tissue. Now this fat of itself does not compose organs. It is deposited in the cells and there it lies, the cells not getting larger but increasing in number, and those cells, like the epidermal cells, are independent of the structure by which they are surrounded. Now the fat has a variety of names, according to the circumstances under which it is presented to us. We call it tallow, lard, grease, kitchen-stuff, suet, butter, or oil, according to its condition, the way it is procured, or the part of the body from which it is derived. Before I speak of the composition I will just inquire as to how this fatty matter gets into the animal tissues. You will see at once that we take a very considerable quantity of fat in our food. We take butter with our bread, and we prefer fat with our meat, and the leanest part of our meat is pierced with fatty matter. We get fat with fish. Maize contains seven per cent. of fat. Barley, oats, wheat, and rye, all contain certain portions of fat. The ox and the sheep get their fat directly from the grass upon which they are fed, as there are certain quantities of oil in their food. But there is another source and that is starch and sugar, which all animals eat, and which are converted into fat in the process of digestion.

Now let me say a word or two with regard to the use of fat before we speak of its composition. Fat is developed much more largely in young people than in old ones. As the fat retires the angles of the bones begin to be perceived, and what we call ugliness follows. Then it is a bad conductor of heat. It is supplied to animals in regions where it is very cold to keep them warm. We find in the bear and polar animals large quantities of fat supplied. It serves the same purpose in the great cetaceans. In the great whales the fat is several feet in thickness, which keeps out the temperature of the water, and also gives them a lightness by which they are enabled to float upon the water with little effort. There can be no doubt that this fatty tissue is of use to those creatures in enabling them to swim with facility upon the surface, and it is also a storer of fuel, and this is a provision for the winter season when their food is less abundant, and when it contains less of the materials by which they can be heated. And we find that the fat is always used for fuel; for animals are always thinner in the winter than in the summer from the fact of their having used the store of fuel put upon their backs to keep up the warmth of the body. And as man passes from tropical to cold climates he consumes more or less of fat. We find in the regions of snow man eats large quantities of fat for the purpose of keeping up heat.

Fat also has another faculty, for it seems necessary to the proper nourishment of the animal body, and where there is a deficiency of fat we find a deficiency of other tissues. In disease when the fat ceases to be deposited then the health fails, and recently oils have been introduced as medicines in diseases in which there is a tendency to lose fat. In consumption especially we find persons getting thinner and thinner every day, but by administering oil the fat

comes again, and with that fat there is a tendency to develop those tissues; and it would appear that the only cases in which consumption has been suspended for any length of time is where cod liver oil has been administered, so that we need not be surprised at its being so generally used. We find fat in the eggs of birds and in the eggs of insects. In fact in the very lowest animalculi we find oil. So much then for the importance of this substance in the animal world.

I now come to speak of its chemical composition. It is to a French chemist named Chevreul we owe all we know of oil. He has described and published this in a book perhaps the most unique in the domain of chemistry. I am happy to say the French government thought so much of the discoveries of Chevreul that they have made him a present of 12,000 francs, which is a gratifying circumstance, and it is also an encouragement to go on. One wishes that something of the sort was more frequent in our own country.

Now just let me explain the general composition of all oils or fats wherever they are found. They consist of 66 parts of carbon, 10 parts of hydrogen, and 8 parts of oxygen. So in 84 lbs. of fat, whatever may be its source, you will find 66 lbs. of carbon, 10 lbs. of hydrogen, and 8 lbs. of oxygen, the oxygen being very small. These substances are not, as you might suppose at first sight, simply mixtures of carbon, hydrogen, and oxygen, but they are compound bodies.

If you take olive oil and put it out in the cold you will find that in cold weather a white substance falls to the bottom: that substance the chemists call stearine. That part which floats above is called oleine. Now if you take human fat or goose fat, for it does not signify which, you will not get stearine, but another substance called margarine, which very nearly resembles stearine, and I shall not make any very great distinction between them except to say that margarine is contained in the human body, and is contained in the goose also, but the stearine and the oleine are found in the vegetable kingdom. Now these bodies are compounds of an acid and a base. The stearine is composed of stearic acid and glycerine. The margarine of margaric acid and glycerine, and the oleine of oleic acid and glycerine. So that you see glycerine lies at the base of all. Now I want just to make this remark with regard to this glycerine that it is not an inflammable body. We may put stearic acid and add glycerine and it will be stearine. Then we may take oleic acid and add glycerine and it is stearine, as I said before, we may leave margarine out of the question.

There is another substance which is used for making candles and burning in lamps which is not an oil at all, and that is this substance petroleum a substance which is now largely brought from the East Indies. It is a mineral production, that is to say, it pours out of the earth, and consists of carbon and hydrogen and forms a substance which we call paraffine, and this paraffine may be obtained in a variety of ways. Price's Belmontine is paraffine, so that you see this mineral substance has come in competition with fat in the manufacture of candles; but we cannot make soap out of petroleum, therefore it is a very different substance to fat.

Now I will dwell for a moment or two upon the glycerine procured from the animal fats. When soap is made an alkali is put into the oil and the glycerine is expelled, so that when the soap maker puts his soda or soda lye into the fat of any kind with which he makes his soap he expels his glycerine, and this was formerly the refuse of the soap maker. It was Chevreul who pointed out its nature and composition, and that it differed materially from stearine and the acids. Glycerine which, at one time was the refuse of the boiler, is now applied to many different purposes. It has been used by the photographer for making one of his solutions. It has been used in medicine. It is a good substitute for cod liver oil. It may be used in tea. Though I do not mean to say that it is a good substitute for sugar, it still contains large quantities of carbon and hydrogen, and in that way it may be substituted for generating fatty matter. It has been applied externally, and although it is the object of the soap maker to get rid of the glycerine, and you may laugh at him for putting it back, yet Belmontine soap is made by the addition of a quantity of glycerine after it has been manufactured, and as an external application it prevents chapping and preserves the epidermis, and is very valuable in the winter on that account. Fish have been kept, I believe, in glycerine for seven or eight years, and they have perfectly retained their colour and their freshness. It has been recommended as a preserver of food, for it is perfectly soluble in water, and has nothing of the stickiness of oil, and food may be used just as if not preserved at all. Then it has been used extensively by perfumers, and is put into a kind of soap which has a quantity of carmine put into the glycerine, and which, being rubbed on the face, gives that healthiness of appearance which makes it so popular. Thus you see the importance of this substance got out of these fats by the aid of chemical agencies.

I will now call your attention to the nature of soap. What we call soap is a salt. We take stearine or oleine and add to this a quantity of soda or potash. When we add soda we get hard soap, and when we add potash we get soft soap. The soda or potash unites with the stearic or oleic acid and forms stearate or oleate of soda or potash. Soap may also be made of margarine, and then with potash we get soft soap. There are further soluble and insoluble soaps. I need not tell you that it would not do to use insoluble soap for washing. What is called diachylon plaster is an insoluble soap. If you look into the pharmacopeia of the London College it will tell you to take a quantity of oxide of lead and boil this with oil. The lead in this case does just the same as the soda or potash does. It goes to the oleic acid and forms oleate of lead, but this oleate of lead is insoluble in water, and therefore we do not use it for washing. Another insoluble soap is that which is formed with lime. If you take this soluble soap and take a good hard water the soap seems to stick about your hands, and you think you could wash a good deal better without the soap than with it. Why? because you have got lime, and the lime goes to the oleic acid, and the soda is lost. And that is what makes hard water expensive, for you keep on washing and rubbing until you get rid of the lime. It would take me much too long to go into anything like detail of these fatty matters, but I may just say that the coarsest kinds of fat, the kitchen grease, the grease boiled out of bones are combined with soda for the purpose of making soap. Curd soap, which is the best material for a washing soap, and is made generally from palm oil, which makes a better soap than any of the other kinds of oil. At the same time these soaps, this mottled soap, this brown soap, and other kinds, are made of coarser materials than palm oil, and to these fats is constantly added a substance which we know by the name of resin. Now resin is a product not unlike oils containing an acid which combines with the soda and forms a soluble soap in the same manner that the fat does, so that the resin, as it were, assists in the production of the soap. It is generally added to the brown soaps. Now there are other kinds of soap which have been introduced of late years, and which are supposed to have been manufactured in different ways, but I may say that there is no other way of making it than by the addition of alkali to the fat and getting rid of the glycerine.

Fancy soaps, of which there are numberless kinds, are generally curd soap reboiled and recast. We have also scented medicated soaps. You may purchase iodine soap, and kreosote soap, and I do not know whether you could not have any kind of soap, but it is always one of the different kinds of soap reboiled down and having various substances mixed with it.

With regard to the soft soaps they are not so pleasant to the skin, and potash is more detergent, so where you want a strong lather it is very desirable to use strong soap. Naples soap, as it is called, is a potash soap. Now passing on from the various varieties of soap, I have said before that this soap made by Messrs. Price, I believe, is really glycerine soap,

and I say this because I charged Mr. Wilson with using a term which I thought was an absurdity. He said, I assure you after that soap is made we add the glycerine, and why? The fact is that they make so much glycerine that they do not know what to do with it, and thus they manufacture it into the soap again, and that is the whole history of this glycerine soap.

Now why do we use soap at all? What is the good of it? After what I have said, I fancy it will puzzle you to tell. We know that we wash with it. But how does it act upon our dirty skins, or linen, or boards, that we should use it in such enormous quantities? Liebig says that the quantity of soap used in a country is a test of civilisation, and it is happy for you Britons to know that you use more soap than any other people in the world. At the same time, you know, no one will say we use as much soap as we ought. Now, in the first place, it dissolves in water, and that is one of its qualities. Now this solution of stearate of soda has a property of holding in solution oil, of making that soluble which while on our skin was insoluble. You rub on a little soap which dissolves off the oil, and with it goes soap and all. The oil has entangled the little particles of carbon and the thousand things to which we are exposed every day, and in this way the soap acts as a detergent. But you may add too much alkali with the oils, and then the alkali will not only dissolve the oil but will actually dissolve those little epidermal scales of which we have spoken before, and the consequence is that by being desirous of cleaning the hands too well we roughen the skin and render it more liable to be dirty, at the same time producing chaps and disease of the skin. All this is the result of using highly alkaline soap. Brown soap, for instance, contains a greater quantity of alkali than curd soap, but the harder the soap the better it is. Be patient with it, rub it up, and that soap contains a good alkali, and will, in the end, serve the purposes of washing better. Now that is just a hint for those who wish to retain very nice clean white looking hands.

Now I must leave the question of soap and just draw your attention, for a little while, to the manufacture of candles. The use of fat or of fatty matters for the purpose of combustion is very ancient, and we read in all past history of men having employed those elements of hydrogen and carbon for the purpose of combustion. Wood contains carbon and hydrogen. Coal contains carbon and hydrogen. We have no blaze without hydrogen, and we have no light given out without carbon. The bad smell which you observe when an ordinary tallow candle is blown out is not produced by the stearic acid, but it is given out by the glycerine. Hence you see when Chevreul had discovered that glycerine was the base of all these fats and tallows he put the candle maker in the way of getting rid of the substance which was most objectionable in the tallow candles. At the same time he never succeeded as a candle maker. I believe he tried in Paris some twenty years ago, but failed altogether. It was left for practical Frenchmen and still more practical Englishmen to realise the benefit of all his discoveries. The great superiority of the candle which we use in the present day is the result of the separation of the glycerine, which will not burn, from the combustible ingredients of the fats. But when you deprive the candles of glycerine you have made a candle exceedingly expensive, and this becomes a matter of serious inconvience. It was, however, left to Mr. Wilson to invent a candle now called a composite candle, partly of tallow, and partly of stearic acid, which does not require snuffing, which gives but little scent when blown out, and is one of these cheap good candles sold in such large quantities in this country, not manufactured by Price alone, but by every maker throughout the country. Belmontine candles are made of stearic acid, from which the glycerine has been separated. Those are more expensive candles. I do not know why we should not give preference to this Belmontine for it does not burn away so quickly. Those are the candles made in the present day by the great candle manufacturers.

Now there is one substance that comes in competition with these fats and oils which I must notice, and that is spermaceti. Spermaceti is not fat, but it is very like it. Instead of glycerine here we have an oxide of cetyle, and it is not worth explaining the difference in the nature of these substances. It is obtained from the head of the great whale. In the large bones of the head of the whale there is this sperm, which is taken and compressed and afterwards bleached, and then you have the beautiful substance called spermaceti, which is easily melted and is poured into moulds to form candles, which burn as well as these stearine candles. They are supposed to be more elegant, and that they are really worth the money they cost. There are hundreds of thousands of tons of spermaceti brought into this country in the course of a single year and manufactured into candles.

Now there are some other uses to which spermaceti is put besides burning. It is rubbed down and made into a very pleasant mixture for colds and coughs. Sperm oil too is a matter of considerable importance in our large manufacturing cities. It is used for the purpose of diminishing the friction of those wheels which are daily producing our necessary comforts. And not only sperm but palm oil and all oils will decrease that friction, and so enable us to work the machinery and wheels, by which we are enabled to spin and weave, to travel quickly on railroads, and to pass rapidly over the broad ocean. Fat in some shape or other is one of the great elements of our civilisation, and that is why we are anxious to get it. The fats of this country are insufficient for its exigencies, and therefore, for their fat, the horses of the Pampas of America are killed, the bears and whales of the Arctic regions, and the oxen and sheep of Africa.

In our next lecture we will endeavour to gather up the materials of waste.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

On Friday Dr. Frankland gave an account of *A New Organic compound containing Boron*, discovered by himself and Mr. Duppa. It is formed by the action of zinc-ethyl on boracic ether. The whole of the oxygen in boracic acid is in this body replaced by ethyl; the composition is therefore expressed by the formula $B(C_4H_5)_3$. The name the authors have given to the compound is *boric-triethide*. It is a colourless mobile liquid, which takes fire spontaneously and burns with a characteristic green flame. The authors are engaged in investigating the corresponding reaction on the ethers of carbonic, oxalic, and silicic acids.

Some discussion ensued on the relations of carbon, boron, and silicon, in the course of which Professor Maskelyne remarked that crystallography does not support the idea of the unity of these bodies, although the physical properties do to some extent.

The next communication was *On the Analysis of some Connemara Minerals*, by Professor Rowney, after which Mr. W. R. Grove read a paper *On the Transmission of Electrolysis across Glass*. If glass, or an equally non-conducting substance, be interposed between electrodes in an electrolyte, so that there be no liquid communication around the edges, it is hardly necessary to say that, according to received opinions and experiments, no current passes, and no electrolysis takes place. Mr. Grove was led by some theoretic considerations to think that this rule might not be without an exception, and the following experiment realised his view:—A Florence flask well cleaned and dried was filled two-thirds full of distilled water, with a few drops of sulphuric acid added to it, and placed in an outer vessel, containing similar acidulated water, and which reached to the same height as the liquid in the interior. A platinum wire was passed through a glass tube, one end of which was hermetically sealed to the platinum, so that a small part of the wire projected beyond the tube. This tube passed through a cork fitted to the flask, and the platinum point dipped into the liquid within the flask, and a similar coated

wire was dipped into the outer liquid, and the two wires connected with the extremities of the secondary coil of a Ruhmkorff's apparatus. Upon the latter being excited by the battery a stream of minute bubbles arose from both the platinum points, proving that electrolysis took place notwithstanding the interposition of the glass. The portions of the flask above the liquid both outside and inside were perfectly dry, so that there could have been no communication of the current over the surface of the glass. This was further proved by removing the outer wire a short distance from the liquid, when sparks passed nearly equal in length to those between wires from the terminals. As the outer wire was further removed, keeping it near the flask, sparks passed along the surface of the latter for a short distance; and as it was further removed from the liquid, still being near the flask, they ceased, thus showing that there was no passage of electricity over the upper and unwetted surface of the glass. With unacidulated water no electrolysis was observed, nor when a battery of thirty cells was used instead of Ruhmkorff's coil. In the first experiment the evolution of gas gradually diminished, and ceased in about twenty minutes, but recommenced on reversing the current. Mr. Grove concluded that the electrolysis was effected by induction across the thin glass of the Florence flask, and that its cessation indicated something like a state of charge or polarisation of the surface of the glass.

Dr. Tyndall opposed Mr. Grove's view that the electrolysis was effected by induction, and suggested that the experiment should be repeated with various kinds of glass, for, when heated, glass shows some conductibility, and some kinds of glass much more than others.

Dr. Frankland observed that he had found it impossible to make small Leyden jars with German test tubes, as the electrical discharge passed through them.

Professor Rowney then read some Analyses of Jet:—

	I. Sp. gr. 1·65.	II. Sp. gr. 1·173.
Carbon	78·60	80·05
Hydrogen	6·21	7·21
Nitrogen	1·27	1·40
Sulphur and oxygen	11·70	10·50
Ash	2·75	0·80

The Professor had also analysed a specimen of coal forming part of a fossil plant. It was composed, of carbon, 82·7, hydrogen, 5·42, nitrogen, 1·77, sulphur and oxygen, 8·57, ash, 1·54.

The President made some remarks on the power of retention of hydrogen which carbon possessed. Dumas had found hydrogen in graphite, but he (the President) could find none.

A description of a new form of blowpipe, for laboratory use, by Dr. Hermann Sprengel, would not be intelligible without a drawing.

The next was a verbal communication *On the Occurrence of Poisonous Metals in Cheese*, by Professor Voelcker. The Professor stated that he had detected both copper and zinc in cheese; in some specimens copper, in others zinc, and in some both copper and zinc. The descriptions of cheese in which these poisonous metals were found were double-Gloucester and Stilton. Skimmed-milk cheese, which was likewise examined for copper and zinc, did not contain any metallic impurity. Inquiry led to the discovery that in many dairies sulphate of copper, and sometimes sulphate of zinc, are employed in the making of cheese. The reasons for which these prejudicial salts are added to the cheese are variously stated. Some persons added sulphate of zinc, with a view of giving new cheese the taste of old! Others employed sulphate of copper for the purpose of preventing the *heaving* of cheese. Dr. Voelcker also stated that he had found alum in Gloucester cheese, and mentioned that he had learnt that in some dairies alum was employed to effect a more complete separation of the caseine from the whey. In the course of his experiments the Doctor said he had found that copper and zinc cannot be detected in an ash when much carbon is present.

Mr. Pochin said that the cases brought forward by Dr. Voelcker must be altogether exceptional, for within his experience sulphate of zinc and sulphate of copper were never used in making cheese.

In answer to Mr. Coleman, the Doctor said that he had not made any quantitative determinations of the substances.

NOTICES OF BOOKS, PATENTS, &c.

Curiosities of Science. Second Series. A Book for Old and Young, by John Timbs, *F.S.A.*

The present series of Mr. Timbs's *Curiosities* relates almost entirely to chemistry. It is a book intended for popular reading, and to popular readers must be of surpassing interest, but there is much in it that will recommend the work as agreeable and instructive reading to the chemist as well.

Mr. Timbs has collected together a great number of facts relating to the history of chemistry, and in the division of the book headed *Alchemy and Chemistry* will be found much curious information concerning those fathers of chemical science the alchemists. It is but recently that our obligations to some of those devoted experimenters have been fully recognised, and that, no longer regarding them as greedy dreamers intent only on the production of gold, or impudent charlatans anxious to delude the ignorant into a belief of their miraculous powers, we have raised them to the rank of experimental philosophers. It is true that in most cases the only object of their experiments was the transmutation of metals, but in the prosecution of their work they acquired a knowledge of the properties of many bodies, and discovered some compounds which more than any others have influenced the progress of true chemical science. It must not be forgotten that it is to them we owe the discovery of nitric, sulphuric, and hydrochloric acids. And pharmaceutical chemistry is still more indebted to them, for most of the medicinal salts of antimony and mercury were first prepared and used by professed alchemists.

The belief in the possibility of transmuting the metals, and in the existence of the philosopher's stone, is probably as general in the present day as ever it was. There are still ignorant and half crazy enthusiasts among the lower classes who busy themselves with distilling sulphur, nitre, salt, and mercury, in the sure and certain hope of finding a lump of gold as the result of the operation, and who easily persuade themselves that the failure is only the consequence of errors in proportion, or an unfavourable position of the planets; while better instructed chemists more reasonably argue from certain analogies that many metals are only "allotropic conditions" of one, and conceive it quite possible that the day may come when our knowledge of the science shall give us the power of changing these conditions at our will. Whenever that day shall arrive, it is to be hoped the modern alchemists will be allowed to follow their employment free from the pains and penalties which awaited their predecessors in this country in the fifteenth century. In the reign of Henry IV. a law was enacted which made the pursuit of alchemy a felony. "This statute" (says Mr. Willcock [1]) "which was supposed to have been founded on the policy of deterring the people from wasting their property in the fruitless search for gold, was indeed merely an act to secure to the king a monopoly in this expected treasure, for, rigorously as it was enforced against private persons, we find that our royal master had established a great laboratory for the manufacture of gold, diamonds, and physic, and pressed into this employment every one suspected of possessing the valuable secret. There are among our records several commissions, not merely indemnifying the alchemists against the pains of the statute, so that the king were supplied with the gold, but others which required all men to pursue and take the offenders, wherever they could catch them, and compel them to

[1] *Laws relating to the Medical Profession*, p. 21.

labour in the Royal Mint." The above mentioned act was repealed in the reign of William and Mary, at the instigation of the Hon. Robert Boyle, "the father of modern chemistry," who possessed a recipe for multiplying gold, and had got up a company in London for its manufacture.

It is curious to find such men as Boyle, Newton, Locke, and Leibnitz believers in the possibility of transmutation when we take into consideration the nature of all the evidence in its favour that could be laid before them. They were all undeceived before they died, but Newton, according to Sir David Brewster, "certainly pursued his experiments to a late period of his life, with the hope of effecting some valuable transmutations."

Leaving the alchemists, and their comparatively fruitless labours, let us turn to Mr. Timbs's book for one fact, which is certainly appropriately classed as a "thing not generally known." How many of our readers know who invented the lucifer match? "The lucifer match was invented in 1827 by Mr. John Walker, a chemist and druggist of Stockton-upon-Tees. He was preparing with phosphorus some lighting mixture for his own use, when by accidental friction, on the hearth, of a match dipped in the mixture, a light was obtained. The hint was not thrown away. Mr. Walker died in 1859, aged 78." Estimating the value of Mr. Walker's invention by the aggregate results in the saving of human labour, we think we might almost claim for him a place beside Arkwright and Watt, and we are glad that Mr. Timbs has rescued his name from the oblivion into which it was falling.

Most of Mr. Timbs's "Curiosities," when not historical or biographical, are facts well known to every chemist, but here is one which we do not remember to have seen before:—

Annihilation of the Smell of Musk.

"Some years ago the emulsion of bitter almonds was found to possess the property of annihilating the smell of musk, and most of the cyanic preparations evince the same power. According to M. Mertot, a druggist of Bayeux, in Normandy, ergot of rye will produce the same effect. This he learned by having to prepare a number of pills containing both musk and ergot, when no sooner were the two substances mixed than the smell completely went off."

Amongst so much material for quotation it is difficult to make a selection, and we cannot do better than advise our readers to go at once to the work itself, which is a sort of chemist's common-place book, full of curious and interesting extracts. We shall only take one more, which shows Sir Walter Raleigh in a new light to most people.

"Raleigh's prison-lodging in the Tower of London is thought to have been in the second and third stories of the Beauchamp Tower. Here he devoted some time to medical chemistry; and here he prepared his celebrated Cordial, which was held in such high reputation in the reign of Charles II. that a treatise on the preparation was then written, under the auspices of that monarch. The original recipe is given by the author; but Sir Kenelm Digby and Sir Alexander Fraser introduced other ingredients. Raleigh appears to have kept the preparation of his cordial a secret during his life. The formula is simplified in the London Pharmacopœia under the name of "Aromatic Confection:" it consists of zedoary and saffron, distilled water, compound powder of crabs' claws, cinnamon, nutmegs, and cloves, smaller cardamon seeds, and double refined sugar, made into a confection."

Superphosphate of Lime. JOHN DYER BRYANT.

THIS patent involves an exceedingly ingenious idea, and although we fear there will be practical difficulties in carrying it out, we sincerely trust they will be overcome so as to enable the patentee to work his process on the large scale. All who have made bone superphosphate, or who have in any way given their attention to it, are aware that it invariably contains a considerable quantity of gypsum; moreover it has hitherto been impossible, from the very nature of the raw material, to prevent its formation. Burnt bones consist principally of carbonate and phosphate of lime; now it is evident that on treating such a mixture with sulphuric acid in excess, the whole of the carbonate of lime will be converted into sulphate, and, moreover, that until the carbonate is decomposed, the acid will be unable to render the phosphates soluble. Mr. Bryant has applied himself to overcome this difficulty by burning the bones at such a temperature as to causticise the carbonate of lime, and then dissolve the quicklime out with, 1st. rain, river, or spring water; 2nd. water mixed with acids, or combined with alkaline or magnesian salts from chemical manufactories or other sources; 3rd. water mixed with bittern, or the refuse of sea-salt manufactories; 4th. sea-water in its natural state, and this latter will, according to the patentee, be generally found the most economical solvent for the purpose.

When bittern is employed, or even sea-water, a double decomposition takes place between the chloride of magnesium and the lime, chloride of calcium remaining in solution, and magnesia being precipitated. The patentee gets over this apparent difficulty by availing himself of the levity of magnesia as compared with phosphate of lime. The stream of fluid is so managed as to wash away the former and leave the latter.

Undoubtedly the processes patented involve more than one chemical and mechanical difficulty, but from the general tenour of the specification we doubt not that the patentee is capable of successfully grappling with them. The importance of the subject is so great that we hope he will be successful.

CORRESPONDENCE.

Copper Smelting—Sulphur.

To the Editor of the CHEMICAL NEWS.

SIR,—The subject of sulphur with reference to cost, supply, and consumption, has lately been noticed in the CHEMICAL NEWS.

Allow me, Sir, to occupy a small space in your columns with a few brief remarks on the above subjects.

A misunderstanding arose between the British Government and that of the kingdom of the Two Sicilies some twenty years ago, respecting the shipment of sulphur from the island of Sicily, as the latter government had ceded to a French company a grant for the exclusive shipment of sulphur from that island.

I was at that time engaged in the neighbourhood of Swansea, and noticed the amount of damage and nuisance caused by the escape of sulphureous vapours from the copper works. It struck me that this might be avoided, and that the sulphur might, at any rate, be made available for the forming of sulphuric acid.

An opportunity was afforded me for trying some experiments on a pretty large scale, and I succeeded in obtaining sulphur from copper ore. The mode by which I attained this was, however, not applicable to the existing plant and *modus operandi* of the established copper works.

I was engaged for a length of time in devising some modification of my plan so as to adapt it to the existing order of things. I had opportunities of making propositions to one or other of the copper smelters from time to time which were always disregarded.

At length I thought of the plan of making a cheap preparation of iron to take up and retain all the sulphur in the slag, a mode to which your correspondent Mr. Smith has alluded in his letter on the *Economy of Sulphur*, which appeared in your paper of the 2nd inst.

I devised an arrangement of furnace for this purpose, so that the process of copper smelting might be conducted by one single continuous operation.

I did not submit this plan formally to the copper trade as a body, but having especial introduction to one of them on

another subject I incidentally introduced my ideas on copper smelting as above. This gentleman entered into my views very warmly, promised me all his individual assistance, and that every facility should be afforded me at their works for carrying my plan into operation. This occurred on my first interview.

I had a particular engagement at that time which prevented me seeing this party again for two or three weeks, at the end of which time I sought a second interview, which I had great difficulty in obtaining. His manner was now completely changed; he would do nothing to assist me, and and entered into a detail relating to the copper trade, some of which it would not be right to mention here, but what he did say amounted to this, that the copper trade was in a peculiar position, in the hands of half a dozen very wealthy firms, having a most perfect understanding amongst themselves; that if my plan came into use this understanding would be broken up, a stop being put to the nuisance from copper works, and so great a saving of fuel effected that copper smelting might be carried on in almost any locality; that the trade would thus become revolutionised. This conversation took place in 1848, the year in which revolutions were so much in fashion.

Finding that the "Copper Trade" was so decidedly hostile to any innovation I abandoned this long-cherished project in despair, as I thought it in vain to submit it to any parties ignorant of the mysteries of copper smelting, since to any such my scheme must have appeared altogether visionary.

I am, &c. J. A.

The Mathematics of Chemistry.

To the Editor of the Chemical News.

Sir,—When any substance is decomposed it is usual to say that the various elementary and compound bodies which are obtained, or the one or other of these, as the case may be, have composed it, and this practically is sufficiently correct; but if we would go only as far as our experience leads us, we should do no more than affirm that the several actions forming the decomposing operation have ended in the formation of these substances, and not insist that they formed the original substance, because experience does not make this appear, and thus it is no more than a presumption. That the presumption is a probable one I am ready to admit, and also that it is almost verified in cases where substances which are known to have been absorbed are afterwards given out, yet I am unable to see that the latter class of facts amount to an absolute demonstration of its truth. I take a piece of chalk, and by subjecting it to heat discover the presence of water[1] and carbonic acid, both of which substances I know it in its present state previously to have absorbed. This may be thought absolutely to prove that these substances composed it, and were not merely produced by the action of the heat, but I am desirous of knowing how it is made out that the water and carbonic acid was as such, by which I mean as these substances only in a state of diffusion, absorbed by the lime. Of course until it can be shown that the lime was united with water and carbonic acid, and was not merely affected by the particles of these bodies otherwise arranged, or even by their forces, if matter is but force, the fact of their after production is of no value as showing that they composed it. By subjecting water to certain conditions we may resolve it into oxygen and hydrogen, and hence it is inferred that these substances compose water: but here I observe the same weakness of argument. It may be considered absurdly sceptical to doubt such conclusions, but if it is thought how desirous it is that probability, however great, should never be mistaken for demonstration, I shall escape condemnation. When oxygen and hydrogen are mixed in a certain proportion we perceive a new substance, and hence say that they have united or combined, whereas we do not know that the atoms of each or their forces have not played upon one another while arranged differently to what they were while known respectively as oxygen and hydrogen; and consequently when it is found that these substances accrue from the decomposition of water, we are unable to consider the opinion that they compose it a demonstrated fact, however probable it may appear.—I am, &c.

J. A. Davies.

[1] The water would be merely an accidental constituent of the carbonate of lime.—Ed.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTY.

Colouring Matter of Rocks.—M. Fournet has presented a second note to the Academy of Sciences[1] in support of his belief in the existence of an *organico-mineral* matter as the colouring principle of minerals. His last note was principally concerned with the brown colouring matter of quartz, but he now expresses his belief that analogous bitumenous compounds are mixed with most stony matters, and even give shades of other colours to a great number of metallic compounds, for nature is not restricted to brown but presents an infinite variety of tints by interposing between the mineral molecules colouring matters of the same kind as the above. The author has examined a great variety of minerals, and finds most of them more or less alterable under the influence of a comparatively low temperature, which induces him to reject at once the notion that the colouring matter is a metallic oxide. In further support of his views he quotes the experiments of several other chemists. Knox obtained from a brown quartz 0·937 per cent. of a kind of naphtha. Heintz procured 0·00273 per cent. of carbon from the amethyst. All the varieties of coloured quartz are easily decolorised at a low temperature, a fact which was known to the ancients; and jewellers have proved that the carbon of smoky quartz is destroyed in a bath of melted tallow. M. Fournet has bleached yellow sulphate of baryta. Wolf noticed that green fluor spar from Siberia lost 0·0416 per cent. under the influence of heat, and from one specimen obtained carbon, nitrogen, hydrogen, and chloric acid (?) The author has decolorised minerals of the same kind, and among others the violet variety supposed to be coloured by manganese. The green felspar of the Ural becomes grey before the mineral attains a red heat. The blue felspar of Greenland Knox found to be strongly impregnated with bitumen, and he also extracted empyreumatic liquids from the white and flesh-coloured varieties. Klaproth observed that sea-green emeralds changed to blue at a strong heat,—an observation which the author confirmed with an *aqua marina*. Lewy has decolorised green emeralds, from which circumstance he also concluded that the stone was coloured by organic matter. Arabic authors notice one particular emerald "*which never changes.*" Patrin noticed certain emeralds of Daourie which emitted an offensive smell, and on the newly separated surfaces of which was found a greasy fluid "*more volatile than ether.*" The author further quotes the microscopic observations of Sir David Brewster, who found innumerable cavities in some crystals, which contained sometimes a gas, sometimes a liquid, and a solid matter of a resinous appearance. It is clear, he adds, that such accumulations must play an important part in the coloration of minerals, as well as influence the results of an analysis.

II. ORGANIC CHEMISTRY.

Action of Iodine on a Concentrated Solution of Cyanide of Potassium.—M. Langlois has observed[2] that when iodine is added to a strong solution of cyanide of potassium, the iodine almost instantly disappears, and colourless prismatic needles are formed. Such crystals are rapidly formed when a solution composed of one part of the cyanide and two parts of distilled water is used. The quantities of iodine and cyanide required to produce the phenomena are represented by the following equation:—

$$KCy + 2I = KI.CyI$$

[1] *Comptes-Rendus*, t. li. p. 39. [2] *Ibid.* p. 29.

These crystals of the iodocyanide of potassium are easily decomposed; indeed they cannot be purified without to some extent modifying their constitution. The bodies which compose them do not completely lose the properties they possessed in the free state. For instance, the iodide of potassium is more easily soluble in water than iodide of cyanogen, so by continuing its action the first of the iodides is completely removed. With ether the reverse takes place; the iodide of cyanogen is removed, and the iodide of potassium is left. By prolonged exposure to atmospheric air the needles lose the iodide of cyanogen, and are changed into cubic crystals. The original crystals are soluble in water, alcohol, and ether, but the last liquid produces some change, and furnishes on spontaneous evaporation new crystals, which contain a larger proportion of iodide of cyanogen.

The properties of the crystals recall at once those of the iodides of cyanogen and potassium. Their solution with sulphurous acid blues starch; it gives a yellowish white precipitate with nitrate of silver, yellow with the salts of lead, and red with bichloride of mercury. Ammoniacal nitrate of silver gives a black precipitate the nature of which the author has not yet determined. The analysis of the crystals gave:—

			Formula. KI.4CyI8HO
Iodide of potassium	18·60	18·91	19·54
Iodide of cyanogen	72·39	72·76	71·99
Water	9·01	8·33	8·47
	100·00	100·00	100·00

New Isomer of Aldehyde.—When glycol is acted on by chloride of zinc at a high temperature, aldehyde and several other ethereal and oleaginous bodies are produced. Among them is one with a remarkably sharp acrid taste. Wurtz separated and analysed a small quantity of this liquid, and came to the conclusion that it was a body isomeric with aldehyde. M. Bauer has followed up the researches of Wurtz.[3] He found that the aqueous liquid produced by the action of chloride of zinc or glycol contained very little aldehyde, but after treatment with a few fragments of chloride of calcium an insoluble ethereal layer formed on the surface of the aqueous solution. This he separated, dried with chloride of calcium, and distilled. Almost all passed between 105°—110°. Analyses proved that this body is isomeric with aldehyde. The vapour density = 2·887, and answers to the formula $C_4H_8O_2$, double that of the oxide of ethylene and aldehyde. The author tried to reproduce glycol from the new body, but could not succeed, hence he concluded that it is not directly related to glycol. He has found, however, that the same body is formed when aldehyde and chloride of zinc are heated together in a water bath. Bauer calls the new body "*âcre-aldehyde*," but no doubt another name will soon be found for it. It boils at 110°, mixes in all proportions with water, alcohol, and ether, and instantly reduces a solution of ammoniacal nitrate of silver. It has a sharp acrid taste, and a penetrating odour. The oily body formed at the same time as the "âcre-aldehyde" is richer in carbon, and boils at a higher temperature.

Oxygen an Antidote for Ether and Chloroform. Though not coming strictly under the denomination of organic chemistry, we may as well notice here the experiments of M. Ozanam[4] on the use of oxygen as an antidote to ether and chloroform. In all the experiments M. Ozanam found that the animals awoke in half the time after inhaling oxygen than they did with simple atmospheric air. The result was just the same whether ether or chloroform had been used. Several animals were placed under the influence of chloroform until the beating of the heart was imperceptible and death imminent, but on inhaling oxygen they quickly awoke. In one experiment the animal respired at the same time the vapour of ether and pure oxygen. It was twelve minutes before the animal slept, and then the sleep was so light that it awoke in a minute and a half, without the continuation of the oxygen. When chloroform and oxygen were breathed together, the animal became drowsy after eight minutes, but did not sleep, and after the inhalations were stopped perfectly recovered in a few seconds. M. Ozanam believes that so long as respiration has not entirely ceased, the revivifying effects of oxygen will be produced, and recommends that the surgeon should always have at his command a supply of oxygen, to reanimate his patient, in case of accident.

[3] *Ibid.* p. 55.

[4] *Ibid.* p. 59.

MISCELLANEOUS.

Adulteration of Food or Drink Bill. — In the House of Commons on Wednesday last on the question that the Lords' Amendment to the above Bill be agreed to, Mr. Warner moved that in Clause I. the word "warranted," struck out by the Lords, should be re-inserted; but after a short conversation the motion was negatived without a division, and the Lords' amendments to the Bill agreed to.

Preservation of Wood from Decay. — A correspondent "J. B. N." suggests the following composition, in preference to tar or ochre, as a preservative of wood from decay, the purpose especially in view being the painting of our decaying gunboats with it:—"Take," he says, "three parts of air-slacked lime, two of wood ashes, and one of fine sand: pass them through a fine sieve, and add as much linseed oil as will bring it to a proper consistence for working with a painter's brush. As particular care must be taken to mix it perfectly smooth, it should be ground on a stone slab with a proper muller, in the same manner as painters grind their white lead, &c. Two coats of this composition being necessary, the first may be rather thin, but the second should be as thick as it can be conveniently worked." This preparation, chemically speaking, appears to be no other than the silicate of lime prepared with potash, or wood-ashes, and mixed with oil, and it is identical in effect with Ransome's patent for the preservation of stone, only the composition is made up with linseed oil as a paint, to be coated over the surface to be preserved.—*Builder.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

The Anti-Adulteration League.—Communications have been received on this subject from the following correspondents. Many of them contain valuable suggestions, a *resumé* of which we will lay before our readers in the course of a few numbers. *C. J. J.* — *F. W.* — *J. Harris* — *L. D.* — *K.* — *A. S.* — *W. B.* . . . . *t* — *A. N. P.* — *A Sufferer* — *E. O.* — *B. R.* — *S. & P.* — *L. M.* — *C. N.* — *T. G. S.* — *X. Y. Z.* — *G. R.* — *J. J. S* — *W. L.*

Enquirer.—We do not understand your first question, and therefore cannot answer the second. The oxygen cannot be "economically" separated from carbonic acid. Iron rust could be economically deoxidised on a large scale.

Sub.—No introduction is necessary before attendance at the College of Chemistry. The laboratory fee is 10*l.* for three months, and for the lectures, attendance at which would be advisable for "one unacquainted with the science," 4*l.* for the whole course. A letter to Mr. Reeks at the Museum, Jermyn Street, would procure you full particulars.

E. H. (Farnworth.)—Will receive an answer by post.

B.—We cannot say when the New Pharmacopœia will be published; but it is expected this year.

F. G.—Cooley's *Dictionary of Practical Receipts.*

☞ Reading covers have been prepared for preserving the numbers of the Chemical News until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

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*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

THE CHEMICAL NEWS.

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ADULTERATION OF FOOD OR DRINK BILL.

THE Adulteration of Food or Drink Bill has now reached such a stage that although it has not yet received the Royal Assent it may virtually be considered as the law of the land. Whether it shall be brought into immediate action, or whether it shall become a dead letter like the Act for Regulating the Sale of Gas, now mainly depends on the various corporations and district boards, but to some extent also, we take leave to suggest, on chemists themselves. If the latter do not perseveringly agitate until the corporations and boards are shamed or forced into action, it will betray an indifference to their own interests, which we venture to assert would neither be exhibited by, nor expected of, any other professional class in the community.

Emasculated as the Bill has been since its first introduction in 1857, it is yet able to confer great benefits if the public freely avail themselves of its provisions, and its execution be entrusted to honest and capable hands. The very knowledge that the machinery for the ready discovery and instant punishment of fraud exists, will of itself be sufficient to deter many from mischievous practices who now speculate on the ignorance and indifference of the public. But this alone is not enough. Some examples must be made. Adulterators must be made to feel that nothing can escape the detection of the chemist, or the more than lynx-eyed penetration of the microscopist. And then the object of the Act will be accomplished. People may eat their pickles and digest their Bath buns in comfort, certain that no copper may give a poisonous verdure to the one, nor arsenic confer a fictitious deadly richness on the other. Bread will then always be a wholesome nutritious article, confectionary a harmless if not a useful luxury, and the thousand other things now embellished with deleterious or diluted with valueless ingredients exactly what nature or prescription intended them to be.

But to achieve all this, as we said before, it is necessary that the vestries, district boards, and town councils should at once be compelled to adopt the Act. It cannot be left to the public, who are but partially conscious of the extent to which they are imposed upon, or to boards the members of which may reasonably be supposed to be adverse to the adoption. It is to those who are best informed on the matter that we look for the initiative in these proceedings. We have done all in our power to assist in carrying the measure, and we now look to our fellow chemists to aid us in preventing the Act from becoming only so much waste paper.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a new form of Chloride of Sodium, by RICHARD V. TUSON, *Lecturer on Chemistry at Charing Cross Hospital.*

THAT chloride of potassium, which ordinarily crystallises in cubes is nevertheless often found as an efflorescence on various vegetable extracts assuming the acicular form is well known.

Hitherto, I believe, the corresponding compound, chloride of sodium, has never been observed in needle-shaped crystals but nearly always in cubes.

Occasionally, however, it deposits from urine in octahedra, and when a solution of the salt in water is evaporated at a temperature not exceeding 14° F. it crystallises in hexagonal tables (Ehrenberg) which contain, according to Fuchs, six equivalents, but, according to Mitscherlich, four equivalents of water of crystallisation. At temperatures above 14° F. these hexagonal crystals lose their water of crystallisation and are resolved into a congeries of minute cubes. Chloride of sodium, it is also stated, may be obtained in large oblique rhombic prisms having the formula $NaCl+4Ag$. They effloresce in air below 32° F. (Mitscherlich), deliquesce (? effloresce) in air above 32° F. (Fuchs), and leave a powder of small cubes.

Lately on opening a tightly-fitting tin box, in which a quantity of salmon-roe paste had been allowed to remain for nearly three years, it was found that the organic matter was covered by an efflorescence of acicular crystals. One of my pupils collected some of these crystals, analysed them, and pronounced them to consist entirely of chloride of sodium. As I had never heard of chloride of sodium crystallising in needles, their examination was repeated, but still the same results were obtained. Some of the crystals were next dissolved in water and the solution produced submitted to spontaneous evaporation, when the whole of the salt deposited in the ordinary or cubical form. This result, therefore, fully confirms the conclusions deduced from analysis.

The crystals, some of which are nearly half an inch long, appear to be rectangular prisms terminated by four-sided pyramids. They are beautifully clear, colourless, transparent, elastic, longitudinally and transversely striated, and many are bent or contorted in a manner similar to the native hydrated sulphate of lime called selenite by mineralogists.

The acicular crystals are anhydrous and undergo no change in form or diminution in transparency when exposed to air at ordinary temperatures, or even at a low red heat. The needles of chloride of sodium possess one property which is a very familiar characteristic of the cubical salt, namely, that when heated they decrepitate. It is singular to remark that, at all events as far as we know at present, the acicular varieties of the chlorides of potassium and of sodium are only developed in the presence of organic matter, just as the production of oc-

tahedral chloride of sodium appears to be due to the solution from which it crystallises containing urea.

Since writing the foregoing I have observed an efflorescence of acicular chloride of sodium on an animal deposit which was sent me for analysis, and which had been originally mixed with a solution of common salt to prevent it undergoing putrefaction.

On some remarkable Relations existing between the Atomic Weights, Atomic Volumes, and Properties of the Chemical Elements, by J. J. Coleman, *Lecturer on Chemistry, and Director of the Laboratory, Commercial College, Making Place, Halifax.*

(*Concluded from page 63.*)

14. It will have been observed that hitherto we have confined our remarks to groups, the members of which have equal atomic volumes. This has been done to avoid confusion, and enable us to make comparisons under like conditions, rather than to attempt any arrangement of the elements in groups.

We shall now be prepared to extend the survey, to enter into a general consideration of the curious relations which exist between atomic weights and atomic volumes, but as we shall not have space to enter into minutiæ (which perhaps it would be unnecessary to do), our attention shall be directed to a few "leading points" in this inquiry.

1st. Taking into consideration the whole of the elements tabulated before us, we will select out such as possess a small atomic weight, and a small atomic volume. Carbon is one, sulphur another, iron a third, zinc a fourth, aluminium a fifth. Now these five elements and all others possessing a similar atomic constitution are characterised by this peculiarity; they are all difficult to reduce from their compounds. In using the term compound here we are not to understand complex compounds consisting of four, five, or six elements associated together. Such must necessarily be unstable. It is simple compounds such as the oxides that are alluded to. We say then that elements having small atomic weights associated with small atomic volumes are with difficulty separated from their compounds; but notice, when such elements are isolated they are endowed with a certain amount of permanency of resistance, but the limit of that resistance is soon attained. What more neutral more inactive than carbon and sulphur under ordinary circumstances? but alter conditions, raise the temperature, for instance, we could not consider them inactive, indisposed, for entering into combination then. Again, what a pertinent illustration is offered by zinc or iron. We well know the properties of these two metals, how inactive they are under ordinary circumstances, but, on the other hand, how easily they are attacked by weak chemical agencies which may be brought to bear upon them.

16. A second class of elements are those possessing with a small atomic weight, a large atomic volume, such as potassium, sodium, phosphorus. Now these elements, like the members of the first series, are all of them difficult to reduce from their compounds, but the resemblance goes no further. The members of the first series have a certain degree of permanency, but these have none, so chemically active are they, so disposed to enter into combination that it is difficult to keep them in an isolated state.

17. The third class of elements are those possessing a large atomic weight associated with a small atomic volume, such as platinum, iridium, rhodium, palladium.

We well know the characteristics of these elements' their capability of resisting chemical and physical agencies, and the little tendency that they manifest towards entering into combination.

18. Next we have a group the members of which possess both a large atomic weight, and a large atomic volume, this constitutes our 4th class, it contains such as antimony, bismuth, mercury, gold. Now, the distinguishing characteristic of this series is that its members are all chemically active, appear to be endowed with a large amount of force, but that force is not manifested, that activity is not exerted, some opposing influence is existing which prevents it, and that influence, whatever it may be, appears to be associated with the absolute weight of the atoms. Thus it would appear that the great weight of the atoms in the members of this series, prevents their chemical activity from being manifested as otherwise it would be, and tends to keep the atom isolated, and in its elementary state.

19. Our hasty review brings us to this very important point—it leads us to suspect the existence of a general law. The relations which we have noticed justify us in concluding that the cohesive or attractive force of an atom is represented by its weight. That this attractive force, whatever it may be styled, is distinct from the force which gives chemical activity to the atom, and further, the best method by which the mode of action of this attractive force can be studied is by connecting together elements having equal atomic volumes. Whether the attractive force be a manifestation of the gravitating force which appertains to all masses of matter, we are not in a position to prove, though it is possible, and indeed appears highly probable that such may be the case, but we cannot trace the *modus operandi* of its action without taking into consideration the causes which act in opposition to it, viz. the repulsive forces associated with the atom.

20. It follows from our investigations that supposing no other force to come into play, the element possessing the greatest atomic weight should possess the least atomic volume; but this we do not find to be invariably the case; thus, in zinc and platinum, the distances of the atoms from each other is the same in both metals, but the platinum atoms have a very much greater mutually attractive force than the zinc atoms. Why? Because the atomic weight of platinum is three times that of zinc. There must therefore be some powerful antagonistic or repulsive force associated with the platinum, or its atoms could not possibly be maintained at so great a distance from each other. Now what is this force which acts contrary to and in a different direction to the cohesive or gravitating force. All we know, all that can be said about it is, that it is a repulsive force; but having come to the conclusions which we have respecting the cohesive force we have perhaps more opportunity of arriving at a correct notion respecting its nature. In the examination about to be made respecting the changes which occur at the moment of chemical combination, we shall be led to notice certain interesting facts which throw considerable light upon the subject, but our immediate object is to show that in a series of compounds, as well as in a series of elements, the compound having the least atomic weight possesses the least chemical activity.

21. Before doing so it will be advisable to advert to certain facts relating to the constitution of those elements which possess the peculiar power of condensing upon their surfaces the molecules of the surrounding medium; thus those elements (or compounds) whose atomic

weights are *high* and whose atoms are closely approximated, possess the property of inducing surface condensation in a preeminent degree; for instance, the element carbon, which is endowed with this remarkable power, not only possesses a small atomic volume, but the smallest of any known element.

Commencing with the first series we have given, it will be noticed that the members of the 1st group, manganese, iron, &c. do not possess the power of effecting surface condensation. Why? Because the atomic weights in each case are small as compared with the atomic volume, but in the succeeding series the atomic weights of some of its members are increased in much larger ratio than their respective atomic volumes, consequently the manifestation of the peculiar power again shows itself, not in all the members of the group, but in those only where the atomic weight is high, as in platinum, iridium, &c. whilst in zinc the weight of the atoms being comparatively small, we are unable to detect any such power appertaining to them, and palladium, standing between the extremes as respects its atomic weight, takes the same relative position when considered with reference to its power of effecting surface condensation. With regard to our next series, aluminium, molybdenum, &c. it is doubtful as to their possessing the property to any extent, and as we descend still lower, arriving at those elements whose atomic volume is very large, we cease to detect it, excepting in some rare instances, as in the case of gold, where the atomic weight is exceedingly high, and even in these cases the extent to which the power is possessed is very small.

22. This method of accounting for surface condensation is not entirely new, for the idea that it is caused by the cohesive attraction of the solid exerted upon the surrounding molecules of gas was put forth by Dr. Faraday some time since in his *Experimental Researches*, series vi. but not only would it appear that the atom is endowed with a power of acting upon the atoms of the medium in which it is placed, but also that the amount of this power is dependent upon and corresponds with the actual weight of the atom. We should conclude then that were all the elements of an equal atomic volume the element possessing the greatest atomic weight would be endowed with this property to the greatest extent, and on the contrary the element having the least atomic weight would possess the smallest amount of such power. It appears then that the repulsive force which keeps the atoms asunder, acting in a contrary direction to the cohesive force, prevents that cohesive force from perceptibly acting upon the molecules of the medium in which the atom is placed.

23. Returning to the point from which we diverged, the atomic constitution of certain compounds will next engage our attention. By dividing the specific gravities of compounds by their respective atomic weights, we get results which express relatively the number of atoms of the compound capable of being contained in a certain given space; such results are termed atomic numbers. Thus the atomic number of oxide of lead is 944, that of hydrogen being one, or in other words, the space occupied by one atom of hydrogen is capable of containing 944 atoms of oxide of lead; but in reality every atom of oxide of lead contains an atom of Pb and an atom of oxygen, so that the total number of elementary atoms contained in the space would be twice 944=1888.

24. The term atomic number we will consider then as denoting the total number of elementary atoms capable of being contained within the space which would be filled by a single atom of hydrogen, and as many such numbers will be quoted, it may be stated that they are all taken from the very elaborate tables in *Gmelin's Handbook of Chemistry*[1], but it must be recollected that Gmelin's atomic numbers represent the number of compound atoms capable of being contained within a given space, whilst the atomic numbers we shall adopt on the present occasion represent the total number of elementary atoms contained within that given space, or, in other words, Gmelin's numbers multiplied by the number of elementary atoms contained in an equivalent of the compound.

25. The first series of compounds tabulated are the compounds of chromium with oxygen:—

	Atom. No.
Chromium	2333
Cr_2O_3	3610
$Cr\ O_3$	2500

Now it will be noticed that the compound in this series endowed with the most inactivity, the most neutrality, possesses also of the three the greatest atomic number, so that in the union of two atoms of chromium with three atoms of oxygen, in the production of this compound, viz. the sesquioxide, considerable condensation must occur. Chromium is chemically active in one direction, oxygen in another, and on bringing the two together in the proper proportions the opposing forces appear to neutralise and balance each other; but if the quantity of oxygen is increased, if with one atom of chromium we unite three atoms of oxygen, a compound is produced, certainly not neutral—it is endowed with great activity—and connected with that activity we observe a very important fact, viz. that its constituent atoms are wider apart than the constituent atoms of the sesquioxide, the neutral member of the series.

26. Let us endeavour to examine the succeeding series in a similar manner. It consists of—

	Atom. No.
Manganese	3220
MnO	2948
Mn_3O_4	3199
MnO_2	3777
$Mn\ O_5$	? ?

Here the peroxide is decidedly the most neutral, the most chemically inactive of the series, and connected with this neutrality we notice that it contains the greatest atomic number, whilst the protoxide and the metal itself, both more active, more ready to rush into combination, possesses a much smaller atomic number. Manganese has a chemical force, a repulsive force which keep its atoms asunder. Oxygen has a chemical force opposite to that of manganese, a repulsive force which keeps its atoms apart, but when the two elements are brought together the chemical force of the one neutralises the chemical force of the other, and, apparently, the repulsive force of the one neutralises the repulsive force of the other, for instant condensation occurs, and a compound is produced, inert, neutral, inactive.

27. Directing attention to the compounds of iron with oxygen, we shall find that the oxide possessing the least tendency to enter into combination, the least activity, is the sesquioxide, the member of the series possessing the greatest atomic number:—

	Atom. No.
Iron	3203
Fe_3O_4	3486
Fe_2O_3	3715
FeO_3	?

The chemical tendencies of iron are in one direction,

[1] Watts' *Translation*, 1. pp. 55, 69, *et seq.*

those of ferric acid in another, and between the two is the neutral point, the point of greatest condensation.

28. Passing on to the consideration of the oxides of tin, we find them arranged in the following order:—

	Atom. No.
Tin	1373
SnO	2202
SnO_2	3093

Tin having the least atomic number, the binoxide the greatest, and the protoxide an intermediate position; and when we come to compare the relative chemical activities of the three compounds we cannot but conclude that the one possessing the greatest atomic number is the most neutral member of this series.

29. If we study the oxides of lead in a similar manner, the same curious relations will be noticed existing:-

	Atom. No.
Lead	1218
PbO	1888
Pb_3O_4	1953
PbO_2	2475

Here we shall have no difficulty in recognising and selecting out the most neutral, the most inactive member—it is the peroxide—the compound possessing the highest atomic number.

The gradual manner in which the atomic number of the compound increases until the lead becomes saturated, neutralised with oxygen, is beautifully manifested by the data which we have before us.

30. The study of the compounds of mercury afford equally interesting results:—

	Atom. No.
Mercury	1485
HgO	1416
HgO_2	2234

Now here we notice that the most chemically active member of the series is the protoxide, the compound possessing the least atomic number. The most neutral member of the series being HgO_2, the compound possessing the greatest atomic number.

31. It is also interesting comparing the compounds of chlorine in a similar manner:—

	Atom. No.
Mercury	1485
HgCl	975
$HgCl_2$	878

Here again we find the most active member of the series, the bichloride, possessing the least atomic number; mercury, the most neutral member of the series, having the greatest atomic number, and calomel, the intermediate member of the series as respects activity, having also an intermediate atomic number.

32. Such are the relations, the broad facts which are revealed by instituting the comparisons which have just been made; we find that when elements having opposite chemical properties, activities in different directions are brought together and formed into neutral compounds, condensation invariably takes place. To seek for an explanation of the phenomena is our natural impulse—that we cannot attempt an explanation without resorting to hypothesis is very obvious—but if we can advance an hypothesis which will connect the facts together, which will tend to enlarge our views upon the subject, and which will not be incompatible with well known and established facts, surely that hypothesis, whatever it may be, is worthy of our present attention. We have no need to imagine the existence of any new force, any new agency; the whole of the phenomena we have been studying can be satisfactorily accounted for on the supposition that the force which gives chemical activity to the atom is identical with the force which keeps the atoms asunder, and that the cohesive power of the atom is represented by its weight; thus potassium has a powerful chemical force, an electro-positive force (if we are so pleased to name it), and that force confers activity upon the atom, and by its self-repulsive nature keeps those atoms widely asunder. Chlorine has an activity of quite an opposite character, an electro-negative activity (if we are so pleased to name it), and the self-repulsive power of that force maintains its atoms widely apart, but, when the two elements are brought together, the activity of the one destroys the activity of the other, the repulsive force of the one destroys that of the other; consequently the cohesive force, a force represented by the weight of the atom, immediately comes into play, and its effects are manifested by the great condensation, the permanent character of the resulting compound.

33. We argue then that it is chemical force, or electrical attraction (for the two terms are by many considered as synonymous) which determines the combination of atoms, but that when combination has actually occurred the very force which occasioned it is masked, or neutralised, and the elements of the compound are merely held together by the cohesive attraction, and that cohesive force corresponds with and depends upon the absolute weight of the atoms.

34. Such is a brief and very hastily arranged record of the author's researches. Much interesting matter has not been touched upon, as the subject is still undergoing investigation, and it is hoped that more interesting facts, and relations of facts, will be yet elicited.

In conclusion, it may be stated that the hypothesis advanced is offered merely for consideration, and must be considered separate and distinct from the numerous facts which it has been the object of the author to bring before the notice of this meeting.

TECHNICAL CHEMISTRY.

On Benzine and Aniline, by M. Parisel.[1]

Preparation of Benzine.—Benzine is prepared in the best and cheapest way from coal naphtha. The naphtha is first agitated with 10 per cent. of strong sulphuric acid. After remaining in contact an hour, the acid is saturated with soda, and the naphtha is drawn off and distilled.

The products of the distillation are very complex. When carefully fractionated, they are found to pass in the following order. Between—

80°	and	85°	Cent.	pure benzine.
85°	„	115°	„	toluene.
115°	„	150°	„	cumene.
150°	„	175°	„	cymene.

At still higher temperatures, various oily alkalies (picoline, aniline, leukol) are obtained, and at the end naphthaline, chryseme, and anthracene, are found.

The benzine of commerce is very impure; it contains a large proportion of the higher homologues of this hydrocarbon. To separate it in a state of chemical purity, it is necessary to rectify repeatedly in a water bath. When pure, it is a colourless, limpid, very mobile liquid, having a peculiar smell, and a burning but not corrosive taste. The specific gravity is 0·85 at 15°. At a low temperature it crystallises in fern-like tufts. The crystals melt

[1] Abridgment of an article in the *Monit. des Sci. Méd. et Pharm.*

at 5°. It distils at 80° without undergoing change. Though but slightly soluble, it communicates its smell to water. Alcohol, ether, and oils dissolve it in all proportions. A mixture of one part of benzine and two parts of alcohol is used for burning in some kinds of lamps. Alone benzine burns easily, but with a smoky flame. Coal gas, by passing through benzine, acquires a much greater illuminating power. Atmospheric air saturated with the vapour gives a luminous flame.

Benzine dissolves sulphur, phosphorus, iodine, camphor, wax, india-rubber, gutta-percha, gum lac, gamboge and copal, and anime resins. It is extensively used as a detergent.

Nitro-Benzine.—The nitric derivatives of benzine are numerous. The only one utilised is that called nitro-benzine, better known in France as essence of myrban, which is extensively employed in perfumery, and occasionally in pharmacy, to give the smell of oil of bitter almonds to various compounds. It is obtained by adding benzine very slowly and carefully to fuming nitric acid; a moderate heat assists the reaction, which is at first rather violent. When the nitric acid will dissolve no more benzine, which is known by the cessation of the effervescence, the mixture is cooled, and then the nitro-benzine separates as an oily liquid. This washed with water and a solution of carbonate of soda, and submitted to one or two rectifications, is obtained in a state of purity. It is a slightly yellowish coloured liquid, which colours deeper when exposed to air. It has a powerful odour of the essential oil of bitter almonds, and a sharp taste. The specific gravity is 1·080. When cooled to 3° it crystallises in needles; it boils at 213°. It is almost insoluble, but gives its peculiar odour to water. Alcohol, ether, and oils dissolve it freely. It acts on animals as a strong poison. Treated with boiling nitric acid it becomes bi-nitro-benzine, and under the influence of nascent hydrogen it forms aniline.

Aniline.—The name of this body is derived from *anil*, the Spanish word for indigo. It was discovered by Unverdorben, in 1826, and has been studied by Runge, Fritzsche, Zinin, Hofmann, Muspratt, Laurent, and Gerhardt. It is commonly prepared by distilling a mixture of one part nitro-benzine, one part acetic acid, and two parts iron filings. An active effervescence takes place a few minutes after the mixture is made, and when that ceases heat is applied and the mixture is distilled to dryness. The aniline in the receiver is mixed with water and acetic acid.

[To form sulphate of aniline the distillate is mixed with strong sulphuric acid (4 parts of acid to 10 parts of nitro-benzine used) and the mixture distilled to expel the acetic acid: sulphate of aniline then remains.]

Pure aniline is a colourless liquid with a strong aromatic odour and a sharp burning taste. Its density = 1·028. It is slightly soluble in water, and very soluble in alcohol and ether. When exposed to the air it becomes yellow. It distils about 200° and cannot be frozen. It coagulates albumen and precipitates metallic salts. In contact with a solution of the hypochlorites it is coloured violet-blue. Chromic acid gives according to the degree of concentration a green, blue, or black precipitate. Nitric acid changes it into picric acid. Iodine, bromine, and chlorine decompose it and form various new bodies.

As a dye aniline has received extensive applications, and many processes have been invented for producing various shades of colour from pale lilac to deep violet. Under the influence of some salts it passes to red and through all gradations of that colour. To some of these the names Fuchsine, Harmaline, Roseine, and Asaleine have been given. Fuchsine, a very agreeable rose colour, is prepared by boiling aniline with a metallic bichloride. Harmaline is made by boiling aniline with dilute sulphuric acid and peroxide of manganese. Asaleine is the result of the reaction of binitrate of mercury on aniline.

Aniline is considered as a *substantive* colour, that is to say, it adheres to the fibre without the intermediation of a mordant.

The following table, prepared by MM. Laurent and Casthelaz, shows what chemistry has up to this time done with coal:—

		Fr. Cent.	Per Kilogramme.
1	Coal	0 04	= 2lbs. 3¼ oz.
2	Tar	4 10	,,
3	Heavy oil	0 20	,,
4	Light oil	1 25	,,
5	Benzine	2 50	,,
6	Rough nitro-benzine	7 ,,	,,
7	Rectified nitro-benzine	12 ,,	,,
8	Ordinary aniline	45 ,,	,,
9	Violet and carmine aniline	75 ,,	,,
10	Pure aniline violet in powder	3 to 4000 ,,	,,

Thus with coal carried to its tenth power we have reached the price of gold.

On the removal of Bisulphide of Carbon from Coal Gas, by the Rev. W. R. Bowditch.

Number 32 of the Chemical News contains an article on the Reports of Dr. Letheby and Mr. Spencer relative to the evils resulting from escapes of gas into the soil of London. Those evils are very great, and it is assumed in the article in question that they are preventible. If they be preventible, and the gas companies do not prevent them, the inference is that the companies are culpable and ought to be compelled to remove an undoubted nuisance.

The interest of the gas companies is identical with the interest of the public in these matters, and it therefore seems remarkable that duty and interest do not lead to improvement if improvement be possible.

Every one acquainted with the subject knows that it is impossible to prevent leakage of gas. No precautions can reduce the loss by leakage below a very considerable amount, and if Mr. Wright's estimate were really reached in London it would indicate most careful management of the gas mains. The smallest leakage which, I believe, has yet been heard of in the United Kingdom occurred at Greenock, viz. 3 per cent. This is stated to be the result of some twenty years of unceasing care and ungrudging cost, and is thought to be so extraordinary that few managers of gas-works regard it as imitable.

The only possible way to remove the evils complained of is that of better purification: in the words of Dr. Letheby, "the supply of gas freer from ammonia and sulphur compounds." The removal of ammonia is a simple matter, for common clay not only removes every trace without injury to the light-giving materials of gas, but by the abstraction of compounds which tend to lessen the illuminating power of gas, it indirectly increases the illuminating power. There is therefore no necessity for "the moisture in the earth to be converted into an acrid alkaline fluid." (p. 57.)

The removal of "bisulphuret of carbon," according to Mr. Spencer, or, according to the far more accurate expression of Dr. Letheby, "sulphur compounds," in the

plural, is regarded as a chemical desideratum. Dr. Frankland, in his article on coal gas in the new edition of Ure's *Dictionary*, says of bisulphuret of carbon, "its presence in coal gas is very injurious, and as there is no known means of removing it on a large scale by any mode of purification, its nongeneration in the process of gas-making becames a problem of great importance."

Is it quite fair to reproach gas companies with the presence of bisulphuret of carbon in gas when "there are no known means of removing it on the large scale?" Would it not be fairer to offer a remedy for the evil and to complain if the remedy were neglected? If Dr. Frankland be correct in his statement made in March last, the gas companies are blameless.

I have now the pleasure of offering a complete remedy for the evils deplored. Not only can bisulphuret of carbon be removed, but by the same process gas can be freed from the sulphur of the sulphuretted hydrocarbons which always contaminate it.

If slaked lime be heated in a tube to 500° F. and purified gas, quite free from sulphuretted hydrogen, be passed through the lime and over lead paper the latter will be blackened. Of course the rapidity of the coloration will depend upon the amount of sulphur in the gas thus treated. The sulphur of the bisulphuret of carbon and of the sulphuretted hydrocarbons has been transferred to hydrogen, and no difficulty exists in removing the sulphuretted hydrogen thus produced. I have tested the gas of sufficient gas companies by this process to justify the conclusion that all gas contains the compounds in question, and that they may thus be removed from gas in general. A current of hydrogen sent through a flask containing some bisulphuret of carbon and over hot lime, in like manner blackens lead paper.

As some of your readers may be disposed to try experiments on the gas with which they are supplied, I will point out one or two precautions of which the observance will save them much trouble. The slaked lime should be sifted through a piece of wire gauze, about 25 meshes to the square inch, and the coarser parts used. This facilitates the passage of the gas. The lime should be dried on the sand bath, and when heated in the tube on the sand bath be blown through with a pair of bellows to remove superfluous water. This prevents cracking the tubes. All the lime in the tube should be kept at the same temperature. I secure this by perforating a piece of ¼-in. brass pipe with holes for about 10 inches of its length to use as a burner in a small furnace, and having my lime in the glass tube of the same length. The heat damages the perforated corks, and the lime is consequently kept about 3 inches from the end of each tube. I would strongly advise the observance of these precautions as saving labour. Should a fuller description of the apparatus be desired I shall have pleasure in furnishing it.

For the glass tube of these experiments substitute gas-works purifiers and the unsolved problem receives its solution.

St. Andrews, Wakefield, July 1860.

PHARMACY, TOXICOLOGY, &c.

Poisoning with Prussic Acid.

LEWES, July 24. Before Lord Chief Justice COCKBURN.

George Ball surrendered to take his trial for the manslaughter of Sarah Ann Ball.

The prisoner was a medical man, not in regular practice, but he attended his mother, a very ailing old lady, and was in the habit of administering small doses of prussic acid for violent attacks of vomiting to which she was subject. On Wednesday the 11th of July, the deceased complained of being poorly, and prisoner procured a drachm or sixty minims of prussic acid from Mr. Roswell, chemist in this town, and administered to the deceased, in the early part of the day, a dose of four minims of the acid, and it seemed to do her good, as she stated she felt better, and in the evening went out for a walk. Upon her return she complained again of being unwell, and the prisoner administered to her another dose of prussic acid, and he was afraid that upon this occasion he administered a deadly quantity, for the deceased had hardly time to go up to her bed-room when she became insensible, and died almost immediately afterwards.

Mr. G. Scrase, surgeon, of Lewes, deposed that he was sent for to the residence of the deceased on the evening in question; and when he arrived she was in a lifeless state, and the prisoner was standing by apparently in a very distressed state of mind. Witness asked what was the matter, and he said he had given his mother seven drops of prussic acid; and witness replied that he thought he must have given her more.

The Lord Chief Justice inquired of the witness whether seven drops would be sufficient to cause death.

The witness said that according to his experience it would not, and that it was the proper quantity to be administered. The smallest quantity of prussic acid on record as having caused death was nine-tenths of a grain.

The Lord Chief Justice inquired what quantity of minims a drop would contain.

The witness said that would depend upon the manner in which the "drop" was obtained from the bottle. If the cork was partly in the drop would be larger than if it was poured out carefully from the open neck of the bottle. Some medical men made use of one method, and others the other; but it was his own practice not to rely upon "drops," but to measure the minims.

By Mr. Barrow: With such a deadly matter as prussic acid he should say that it certainly was not prudent for any medical man to rely upon the "drops," and he ought to measure it. The proper doses, as marked upon all the bottles of prussic acid of Scheele's strength, to be administered were one, two, or the largest three minims. Scheele's acid was not uniform in strength, sometimes it contained four per cent. of acid, sometimes five, and sometimes as much as six per cent.

The Lord Chief Justice: Would not that amount to almost just the difference between life and death?—Witness: It would make a very great difference, certainly, and Dr. Taylor and other eminent medical men have recommended that Scheele's acid should not be made use of, on account of the very great variation that exists in its strength. I myself always use the acid of the Pharmacopœia, but, notwithstanding what has been written upon the subject by many eminent medical writers, Scheele's acid is generally made use of by the profession.

The Lord Chief Justice: Supposing this acid to be of the highest strength you have mentioned, do you consider that seven drops would have been sufficient to cause death?—Witness: I do not believe they would.

By Mr. Barrow: Six per cent. is an exceptional strength, but I should think it would take seventeen minims, even of that strength, to cause death.

The Lord Chief Justice: What do you say is the difference between a "minim" and a "drop?"—Witness: That would depend upon the sort of "drop." (A laugh.) The witness then stated that the prisoner afterwards gave him a bottle which contained prussic acid. He told him

that he had given his mother four minims in the morning, and twenty-five minims remained in the bottle. He did not test the strength of the portion that remained, and he had no doubt that the deceased died from the effects of prussic acid.

By Serjeant Ballantine: There was a broken cork in the bottle when the prisoner gave it to him. In his opinion seventeen minims of prussic acid was the smallest quantity that would destroy life. It was very easy to make a mistake while dropping the liquid from a bottle. When the prisoner told him that he had given the deceased seven drops, he understood him to mean that he had administered a dose to the extent of three and a half minims. He had never heard of any instance where Scheele's acid had exceeded six per cent. in strength.

Mr. G. H. Roswell, a chemist at Lewes, deposed that on the 11th of July the prisoner came to his shop and asked for some prussic acid, and he gave him a drachm; the drachm would contain sixty minims. He did not measure it, but gave what he considered to be one-fourth part of the bottle.

Serjeant Ballantine: As you say you did not measure it, can you tell us how much prussic acid you really did give to this gentleman?—Witness: I cannot say to a drop. I am sure he had fifty drops. I consider a "drop" and a "minim" synonymous terms. I gave the prisoner about the quantity, but when prussic acid is dispensed by a medical man he is, of course, careful as to the quantity he uses.

Lord Chief Justice: We have been told that a "drop" contains two minims, and this witness says he looks upon the two terms as synonymous.

Serjeant Ballantine (to the witness): If you were told to give a patient so many "minims" should you give him so many "drops?" (A laugh.)—Witness: Certainly not. (Renewed laughter.)

Serjeant Ballantine: Can you tell us the strength of the acid you sold?—Witness: I don't know what strength it was. I should think about four per cent.

Serjeant Ballantine: I am much obliged to you for your candid answers in reference to such an article as prussic acid. (Laughter.)

This was the case for the prosecution.

Serjeant Ballantine then addressed the jury for the prisoner with his usual power and ability. He proceeded to contend that, in the first place, it was not at all clear that this unhappy lady had died from an excessive dose of prussic acid. The medical evidence was very vague upon that subject, and the chemist who had sold the article could not give them any information as to its strength. The prisoner ought not to be convicted because the article he administered was supposed to be of excessive strength, when he was entirely ignorant of the fact; and he could not help expressing his opinion that it was a very unsatisfactory state of things for the public that they should be liable to have such articles administered to them. As to the suggestion that the death had been caused by the administration of an excessive dose of this deadly ingredient, it appeared to him that the evidence by no means was sufficient to establish that fact; and although it was represented that a certain quantity only remained in the bottle, and from this it was sought to be inferred that the remainder had been given to deceased, yet the jury would not forget that there was a broken cork in the bottle, and for anything that appeared to the contrary a considerable portion of the liquid might have escaped.

The Lord Chief Justice summed up, and, having explained to the jury the law in reference to such a case, he proceeded to call their attention to the facts, and he observed that the fact of the cork being broken and defective was certainly an important matter for their consideration, as it admitted the probability that the acid might have escaped from the bottle accidentally, and there would be an utter absence of evidence that an excessive dose had been administered by the prisoner.

The jury almost immediately returned a verdict of Not guilty.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On recent Researches in Physical Geography and Geology, by Professor T. D. Ansted, *M.A. F.R.S.*

Lecture III. *Central Africa and Central Australia.*

The various departments of physical geography have close relation one with another, and the facts discovered with respect to one part of the world often help us to understand districts far removed in point of distance and apparently having few things in common. Thus to proceed from an account of the bottom of the Atlantic to consider the little known interior of two of the six great continental tracts may seem to require explanation. Such explanation will, however, be better given in the progress and conclusion of the lecture I am about to deliver than by occupying your time in preliminary remarks.

It is not many years since the authentic maps of Africa and Australia presented an utter blank, while the less conscientious and more showy attempts to fill up that blank admitted and encouraged free play for the imagination. The energy and self-devotion of a large number of travellers in both countries have since been rewarded, though very slowly, by important discovery, and the interior of these countries is rapidly becoming known, the maps now delineating facts both of physical and political geography.

There is, however, a reason why knowledge should so long have been kept back in reference to these countries. In Africa some coast line of some 14,000 miles encloses an area of nearly 9 millions of square miles, and Australia, although provided with a greater proportional length of coast, can hardly be said to possess more than one river of importance, and this drains only the south-eastern district, leaving most part of the remaining 2¼ millions of area without rivers. No wonder that two countries, one having scarcely any sea-ports and the other hardly any rivers entering the sea, are difficult of access and little visited.

It is a lesson learnt in very recent times that the material prosperity and rapid advance in civilisation of a country depends chiefly on physical causes. But few are aware even now of the close relation between physical and political geography, and the mutual dependence of both on geological structure, and many great lessons have still to be learnt by all of us on these subjects.

I propose in my lecture to-day to remind you as briefly but as clearly as I can of the history and progress of discovery in Africa and Australia, with a view to show you that the great secret of the apparent and real impenetrability of these countries is owing to their structure and outline, and that these structure and outline are phenomena by which these lands differ from Europe, Asia, and the two Americas, but agree to some extent with the form of some of the ocean floors.

I have a trying task before me in undertaking to reach such a conclusion, but I must assume that your memories will only need to be refreshed in reference to many classes of facts.

The Portuguese discovered a great part of the southern shores of Africa, both on the east and west side, and by their jealous system of exclusion closed them for a long time

against all access. They certainly knew much of the interior and more of the coast a full century ago, but it is only within half a century that general information has begun to spread.

Let me first direct your attention to what has long been known of the physical geography of Africa. In order to give you an idea of the progress of discovery I have suspended two maps of different dates — the one is dated 1810, and the other about 1830. Those two maps are perhaps about the most correct I can point out. The one is by Arrowsmith and the other is by a good German publisher, and those two maps mark what was known of the interior of Africa at their respective dates.

Africa contains a certain number of rivers. The Nile has a long straight course at its lower or northern part, and in its upper tributaries has been the object of great exploration, the main points not being pet perfectly made out. The Nile is one of the principal rivers of the world, and drains a great portion of Africa. It runs through Egypt into Abyssinia, and doubtless there drains a large district, but it is not known with certainty. It has a course of between 3000 and 4000 miles. The Niger, as it used to be called, a river now known as the Quorra or Joliba, is perhaps the next most important river of Africa. It debouches just in the hollow of the Gulf of Guinea, and has a range of probably not less than 3000 miles. Just however as the Nile descends along the north-eastern corner of Africa, so the Niger runs entirely in the western elbow of that continent, a little north of the coast of Guinea, and scarcely anywhere else. The Niger takes its rise in the coast range, running first east and then north-east, till it turns to the south, and empties itself in the Gulf of Guinea. There is also a branch coming in from the east. The river drains the country in the western extremity of Africa for a considerable distance by means of its tributaries, many of which, like those of the Nile, may probably extend far into the interior of the country. It used to be a favourite theory that the Nile and the Niger, and may be true, were connected together either by a lake or swampy tract of country. The next river of importance is the Zambesi. Though not quite of such importance as the others, it was familiar to the Portuguese, and it has been visited lately through the exertions of Dr. Livingstone. But until Dr. Livingstone came back the Zambesi was very little known indeed. It crosses almost the whole of South Africa, and connects with rivers originating very near the western coast, and draining the country to the northward. It has a large number of tributaries, whose sources are within ten degrees of the equator. Its length has not been determined, but it is probably not much inferior to the Niger, and cannot therefore be much less than 3000 miles. The Orange or Gariep river is next in importance. It crosses the South of Africa, and drains the country south of the Zambesi. Its course is more than 1000 miles long. The next river is the Zaire or Congo, which is of not much less importance. It seems to run northwards.

You see that although I have mentioned all the important rivers of Africa, all these rivers are, with the exception of the Zambesi, quite close to the shore, scarcely penetrating the great mass of Africa, except round and outside the wall surrounding it. Thus the Nile drains the north-eastern corner; the Niger that coast which comes in under the shoulders of Africa by the Gulf of Guinea; the Orange river drains only the district north of the Cape, and the Congo only the country between the coast and the mountain chains. The whole vast district of the interior is therefore undrained by any known rivers.

The mountains of Africa will be described in a very few words. There is one great chain of mountains, the Atlas Chain, which I shall not speak of, as, although it is in Africa, it has nothing to do with the physical geography of that continent, nor is it connected strictly with its geology. The Atlas is a chain of mountains that has been crossed in various directions, and is very interesting in its character. It terminates that part of Africa where the country goes south by Tunis. It may probably be rather regarded as another branch of the chain which comes across Europe by the Alps and the Pyrenees, and enter the Atlantic there. The south branch incloses the western Mediterranean. What then are the mountains of Africa? Strictly speaking there are none. There are small mountain knots apparently in the interior, but there is no important tract of mountain country except in Abyssinia, on the south-eastern part or eastern fork of the Nile, which is in fact the source of several of many of the feeders of the river. No doubt a mountain group, although not a mountain chain, is here present. Then again this mountain group has much to do with the mountains that come down and form the southern extremity, connected with Mount Sinai. This Mount Sinai, or Djebel Tor range, crossing into the centre of Abyssinia, forms a mountain knot of considerable extension. From this mountain knot issue many of the principal feeders of the Nile. It is the nucleus and highest part of an elevated plateau, rising into lofty peaks, which for the greater part of its extension is table land, broken by occasional fissures. This tract of high land seems to extend southwards, gradually getting lower and lower, until it has an elevation of about 6000 feet, after which it continues, with comparatively little change, as a broad bell, fringing the whole of the eastern coast. Out of it arise occasionally and abruptly hills of small elevation, and it sometimes sinks. The hills thus seen are not properly mountains, though they have a mountain character. They are not like the Alps and the Himalayas. They are abrupt and mountainous peaks arising out of elevated tracts. In this form they have been traced at intervals southwards. They are broken at various places by something in the nature of gorges, but for the whole distance as far as the Zambesi there is no break of any importance. At the Zambesi there is one opening, but further south there is nothing more. The hills continue at an elevation of from 4000 to 7000 feet, at a distance of 100 or 150 miles in the interior, the breadth of the range being from 50 to 100 miles, and form a sort of belt running southwards to the Cape of Good Hope, and thence northwards as far as the Gulf of Guinea. At that part they approach the coast, and rise to an elevation of 14,000 or 15,000 feet. Afterwards the coast range turns westwards and continues following nearly the line of the coast towards Senegal. It then appears to branch off to the east into the Great Sahara or desert of Africa. In the parts of this desert which have been crossed there seems generally a range of high ground, which terminates eastwards on the banks of the Nile, in the Libyan Desert, not far from Abyssinia. There therefore appears to be around the whole of Africa a zone or belt of mountainous table land.

With regard to the other parts of physical Africa, the deserts appear to be most remarkable. That great district which extends northwards almost to the Mediterranean was so little known at one time that it was supposed to be almost entirely barren country, but it is by no means so barren or unfit for occupation as it was supposed. In point of fact, although it occupies so vast a tract, there are at distances often not very considerable watered and cultivated portions. These are sometimes called *oases;* but they are not mere oases in the sense in which the word is generally understood, they are large cultivated districts of land separated from arid districts. The northern parts of this district seem to be of a dry sandy desert, in the proper sense of the word, but beyond these the mountains of the Atlas range belong in a certain sense to Europe rather than Africa, and if they were connected at the Straits of Gibraltar, instead of being disconnected, and the Atlantic entered on the south side of the range instead of the north, Africa proper would retain all that is essential to its proper physical geography. Portions of the desert are below the level of the Mediterranean, this result having been produced by some change in comparatively recent times.

Not a very long time ago there was extant a theory of African geography to this effect. It was known that there was a great sahara or desert in the northern part traversed

with difficulty, and it was supposed that almost to the Cape of Good Hope this desert continued. I need not inform you that that theory is completely put an end to by the observations of travellers who have visited the interior. It was next supposed that the whole of this vast tract of country was composed of steps or terraces, rising to a great elevated chain, called the Mountains of the Moon. This name of the Mountains of the Moon belongs indeed to ancient Greek history, and as a name is familiar to the Arab in the north, and therefore geographers thought it must mean something important. There is good reason to know that as a great east and west chain near the equator these so called mountains do not exist at all. Afterwards, when it was proved by incontestable evidence of travellers that this theory could not be the correct one, another theory was started, namely, that the whole of the interior of Africa was composed of a series of terraces, but that these descended towards the centre, so that in the interior there was a great space of lake country, occupying the whole of the central part. That theory is also exploded, and the present notion is very different to either of these, though a modification in some sense of the depressed plateau theory. It simply states the result of observation, that the interior of Africa is to a certain extent depressed below the general level of the high land around the outside near the sea, but that this depression is not so considerable as to bring it down to anything like the level of the sea—that it is a comparative hollow, partially filled up with lakes, which are not of the nature of the lakes in the better known continents, such as those in the Swiss mountains or in North America. They are mere lagoons or expanses, occasionally occupied with water, always shallow, some of them drying up during the dry part of the year, but during the rains often occupying enormous spaces. They thus differ much in dimensions at different seasons, and in the case of one of them, Lake Tsad, south of Tripoli, there can be no doubt that its dimensions, sometimes 80 or 100 miles in diameter, dwindle down occasionally until it is almost if not quite dry. There can be no doubt also that some of the other great lakes, and two or three smaller lakes, not marked on the map, are similarly circumstanced.

(To be continued.)

NOTICES OF BOOKS, PATENTS, &c.

An Introduction to Practical Pharmacy: Designed as a Text-book for the Student, and as a Guide for the Physician and the Pharmaceutist, &c. By Edward Parrish. 2nd edition. Philadelphia: Blanchard and Lea, 1859.

When we say that this book is in some respects the best which has been published on the subject in the English language for a great many years, we do not wish it to be understood as very extravagant praise. In truth, it is not so much the best as the only book. It is strange, but it is not more strange than true, that we have not in England at the present time any work which can be recommended as a text-book for the student of Pharmacy. Brande's *Manual*, we believe, has long been out of print, and was to some extent out of date before it was out of print. Dr. Redwood's adaptation of Mohr's *Manual of Pharmaceutical Technology* is only a description of pharmaceutical apparatus and manipulations. We have some good books on Materia Medica, but those contain much that it is not supposed necessary for a pharmaceutist to know, and do not contain that particular combination of scientific and practical information on the composition and preparation of medicines which should be found together in a work intended for chemists and druggists.

Nor is it for the instruction of pharmaceutists alone that a good work on pharmacy is needed. Mr. Parrish's book is designed as a guide for the prescriber as well as the pharmaceutist; and the continual experience of dispensers in this country shows how little medical men often know of medicines beyond their names and possible effects. The frequency with which substances are directed to be formed into pills which cannot by any possibility be made to cohere, the ingredients constantly ordered in mixtures which will not mix, and consequently, however active, run the risk of being swallowed either in the first or last dose taken out of the bottle, and the various chemical incompatibilities which are occasionally collected together in one prescription, indicate an amount of ignorance of the physical and chemical properties of medicines which would be surprising if we did not know that the practical study of pharmacy does not necessarily form a part of a medical man's education.

The word pharmacy has to some extent changed its signification. In the first edition of his *Manual* Mr. Brande defined Pharmacy as that "branch of knowledge which relates to the medical and chemical history of the different articles of the *Materia Medica*, to the mode of prescribing them, their effects, and composition. In these days, in England at least, it is only supposed to relate to the chemical history, the composition and the mode of preparing medicines. With the medical history, the effects, and the mode of prescribing medicines, pharmaceutists are now supposed to have no more concern than prescribers with the preparation of them. And the change has worked badly on both parties. If professional jealousy has made a stricter division between the compounder and the prescriber, the enforced ignorance on the one side has entailed a corresponding ignorance on the other, and it is now no unusual thing to hear even medical men lament that the art of prescribing is almost lost.

We cannot say that Mr. Parrish's book at all comes up to our idea of what a work on pharmacy should be, it being often deficient in the practical information to which we have alluded above. It is of course based on the United States' Pharmacopœia, and is therefore adapted to the peculiar conditions under which pharmacy is practised in the States. This renders the work, to a certain extent, inapplicable to the wants of English pharmaceutists; but still there is much in it which is of universal interest.

The book is divided into five parts. The first is devoted to a description of the furniture and implements necessary for a dispensary or shop, the weights and measures made use of, and the United States' Pharmacopœia. We might take an exception to this part, which is not exclusively applicable to the work we are now noticing. It is overdone with illustrations. There are few individuals we imagine, not to mention grown-up pharmaceutists, who are not sufficiently well acquainted with the appearance of a pestle and mortar, an evaporating dish or a funnel, as to render it quite unnecessary that an accurate delineation of these important and useful utensils should accompany any casual remark the author may think it right to make on them. We believe, then, that such illustrations may well be spared, and the space they occupy devoted to more useful matter.

The weights and measures made use of in the United States' Pharmacopœia, are the same as those at present in use in England. Mr. Parrish notices the inconvenience of the apothecaries' weights to those who manipulate with large quantities of drugs, and he gives the following as the simplest rule he is acquainted with for converting apothecaries' into avoirdupois ounces. It is not strictly accurate, however, but gives a pretty close approximation. We extract it, thinking it may prove useful to some of our readers: —

"To convert a grain of officinal into avoirdupois ounces, add $\frac{1}{13}$ and $\frac{1}{200}$ to the number. For example, to find the value of 24 officinal ounces in commercial ounces —

$$24 + \frac{24}{13} + \frac{24}{200} = 26{\cdot}12 \text{ or } 26\tfrac{1}{2}.$$

We need not quote more from this useful chapter, because, as our readers know, our own system of weights will be changed in the forthcoming British Pharmacopœia. This is not the place to discuss the policy or impolicy of the proposed change, but we cannot help expressing a hope that the Medical Council will consider the matter well before they

make the contemplated alteration in the grain, hitherto the common standard of both Apothecaries' and Avoirdupois weights. The most bewildering confusion will ensue for a time, whatever change is made, and it will be fortunate if a few accidental poisonings do not result; but the greatest confusion will certainly be caused by the difference in the weight of the grain.

A writer on pharmacy, of note in America, Dr. E. R. Squibb, has recently[1] recommended the abolition of measures of capacity altogether, and the estimation of quantities by weight alone. "The objection," he says, "to measures of capacity in an authoritative standard, is the want of accuracy in practice entailed by incorrect adjustment and graduation, by differences in reading the measuring line, and by the change of volume incident to change of temperature in liquids." The last objection might easily be passed over, but the incorrect adjustment and graduation of glass measures is at times so serious a matter as almost to justify the inspection of them by the Excise or College of Physicians. It is rare to find two measures which exactly correspond. The minim drachm measures sometimes show differences varying from two to ten minims. In the larger measures the errors are of course still greater. The apothecaries' weights in common use also demand some attention and regulation. It may be safely said that these are never accurate. The two drachm weights sometimes vary by as much as three or four grains, the six grain weights often show a difference of more than half a grain, and it is seldom you can find two single grain weights which are exactly alike.

The use of a drop as a measure has been strongly objected to on account of its variable size, dependent, of course, upon the size and shape of the vessel dropped from, the specific gravity of the liquid, and other causes. We do not think much greater accuracy would be secured by using a minim measure for very small quantities, especially as they are graduated at present, and as the drop will continue to be used, we quote a table from Mr. Parrish which exhibits the differences under some conditions. It is clear that a good deal of ignorance on this matter still prevails, for on a trial at Lewes, a few days ago, one witness said he considered "minim" and "drop" as synonymous terms, while another stated that the drop was equal to two minims.

Table of the Number of Drops of different Liquids equivalent to one fʒj as dropped from a Pint or Half-pint Tincture Bottle, and from a Minim Measure. Thermometer 80°.

	From ♏ Measure.	From Oj or Oss Bottles.
Acid Sulph. dil.	49	54
„ Hydrocy. dil.	52	—
Alcohol	143	118
Aqua	46	64
Chloroform	276	180
Liq. Ammoniæ	62	49
„ Hydrarg et Arsen. iod.	52	52
„ Potass. Arsen.	63	60
Ol. Menth. Vir. (old)	103	110
„ Tiglii	92	80
Spt. Æther Nit.	148	90
„ „ Co.	140	90
Tinctura Aconiti	130	118
„ Camphoræ Co.	110	95
„ Opii	147	106
Vinum Antimonii	84	62
„ Opii	92	78

Our readers will see that the numbers obtained by Mr. Parrish differ considerably from those of Mr. Allsop, which is another illustration of the differences in measurement of a drop.

We shall return to the work for several useful things which we have marked for extraction, and in the meantime recommend it as a book likely to prove useful to many of our readers in the present dearth of pharmaceutical literature.

[1] *American Journal of Pharmacy*, Jan. 1860.

CORRESPONDENCE.

Prevention of Smoke. Economy of Fuel.

To the Editor of the Chemical News.

Sir,—Any mode of economising fuel for steamships, on long and distant voyages, must be regarded of the highest possible value, and worthy of especial attention.

I forward you some notes and memoranda bearing upon this subject, in which it will be seen that a blast is recommended for keeping up steam generally, as the most certain means of preventing the escape of coal smoke and of economising fuel.

In the report of the experimental trip made with the Great Eastern steamship previous to her departure for America, it is stated that sufficient steam could not be obtained from the boilers to keep the engines at full work; moreover, that the funnels became very highly heated.

Now this exactly tallies with an opinion expressed in the papers referred to, that the waste of heat, that is of fuel, by the draught of chimneys and funnels, is incalculable. As this subject is, in my opinion, one not altogether foreign to the objects of the Chemical News, I send you these papers, as there is a chance that these remarks may meet the eye of some intelligent individual, not biassed by prejudice, having influence at the Admiralty, or with some of the large steam navigation companies, so that the principle may at some time be put to the test of practical working.

Regarding this subject as one of great national importance, I make no apology for introducing it to your notice.

I am, &c. C. J. Smith, C.E.

The abatement of the nuisance of coal smoke in manufacturing towns has long been regarded as a great desideratum.

A certain mode of consuming smoke must be attended with the saving of fuel. This should be a subject of interest to all consumers of coal, but in cases where coal is of the greatest value, as in steam navigation, an amount of economy ought to become a matter of paramount importance.

The first cost of coal is trifling when compared with transport, and the other drawbacks attendant on the supply and use of coal for steamers on long and distant voyages.

It is quite possible to use ordinary coal in the fireplaces of steam boilers so that little apparent smoke shall escape. By keeping a thin fire, and supplying small quantities of coal repeatedly, thrown on to different parts of the fire in succession, so that one portion of the fuel may be always in a clear and active state of ignition. But it is in vain to expect that the present race of ordinary stokers will devote sufficient care and attention to insure a perfect result.

The principle upon which smoke is to be consumed, as is well known, depends on the admission of an adequate quantity of fresh air or oxygen to the surface of the fire, and maintaining there a sufficiently high temperature to cause the air and the gaseous or volatile matters disengaged from the coal to combine into flame. It is this latter condition which presents the chief difficulty, and which can only be effectually insured by the use of a blast, against which much unfounded prejudice very generally prevails.

When it is proposed to engineers or practical mechanics they look grave, shake their heads, and talk of the great expense and extra power which would be required. These remarks would be just in regard to iron works, where a strong pressure blast is required to work large furnaces and cupolas, but to keep up combustion in steam boiler fires a fan blast will be sufficient, in respect to which too much misapprehension prevails, arising, no doubt, from the vain attempts to produce a pressure of blast by means of a fan.

It is a common thing in iron foundries to see a fan revolving at an enormous speed, having only a small pipe to carry off the air, the consequence being that the air is kept purling round in the fan, while only a small portion can make its escape, thus causing a great waste of power and a most disagreeable humming noise.

When a large fan is used, working at a moderate velocity, not to exceed 750 revolutions per minute, and having an ample aperture for the escape of the air, which should be one fourth of the circumference of the outer case of the fan, a large volume of air would be thrown off by the application of moderate power, and free from any disagreeable humming noise.

To the opponents of the blast a few queries may be put, such as, "How is such extraordinary power obtained from so small a boiler as that of a railway locomotive engine?" And further, "How is so great a speed obtained on railways?" To these a reply in main may be made:—"By the use of the blast, or what is tantamount to one, by discharging the expelled steam into the funnel, which has the effect of keeping off all downward pressure of the atmosphere and throwing it all upon the fire; at the same time the almost incessant charge of steam in the funnel prevents the escape and waste of heat which takes place in the chimneys of stationery engines, and which is necessary to keep up the requisite draught to the fires.

It may be further asked—"What is the chief cost of power?" It is, for the most part, merely the cost of the coal to convert so much water into steam.

Let it be assumed that by the expenditure of two per cent. of power for working fans a saving in the gross consumption of coal to the extent of upwards of 40 per cent. may be effected, it seems desirable that the principle should be fully and fairly tested.

Whenever the use of a blast is introduced into steam navigation, it may be expected that the size and weight of boilers will be greatly reduced, a speed hitherto unknown will be attained, and a great saving of coal effected.

These remarks are not made with a view of inducing any individual or single navigation company to apply the proposed plan to any of their steamers, but rather to suggest that an association, composed of persons deeply interested in the extension of steam navigation should be formed for the purpose of carrying into effect the ideas expressed in the printed papers sent herewith.

The use of a blast for generating steam generally will be found highly advantageous, but for war steamers in particular it is most strongly recommended.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Arsenical Colours. — Erdmann and Ziureck[1] have frightened the ladies of Leipsic and Berlin with the discovery that some green tarlatans were coloured with arseniate of copper. The colour was merely fixed on with starch paste, so that the least friction sufficed to remove it. Erdmann also speaks of a colouring matter known as cochineal red which contains a good deal of arsenic in the form of arseniate of alumina. At Berlin Herr Ziureck was officially appointed to investigate the matter, and he found a good many specimens of green tarlatans which were coloured with the arsenical preparation applied superficially as described by Erdmann. Certainly the air of a ball-room in which many of such dresses were rubbed together would become rather strongly charged with poisonous matter.

Preparation of Phosphorous Acid, by M. H. Schiff.[2]—When phosphorus is placed in a solution of sulphate of copper it by degrees becomes covered with brilliant crystals of metallic copper which slowly change into phosphide of copper. If the operation be conducted out of contact with the air, and the solution be renewed by occasionally adding crystals of sulphate of copper, there is obtained a very acid liquor containing only sulphuric and phosphorous acids. By neutralising one half of this solution with lime or baryta, and then adding the other half and shaking the mixture for several days, all the sulphuric acid is precipitated and a solution of phosphorous acid is obtained.

II. ORGANIC CHEMISTRY.

Alkaloid of the Coca.—The leaves of the *Erythroxylon Coca* are used in Peru as a stimulant like opium, and from them Niemann, the assistant of Wöhler, has succeeded in isolating the active principle, an organic base, to which he has given the name of *Cocaine*.[3] This alkaloid crystallises in small colourless prisms. It is slightly soluble in water, much more so in alcohol, and freely in ether. It has a strongly alkaline reaction. Applied to the tongue it is found to have a bitter taste, and occasions a transitory insensibility to the part touched by it. At 98° it melts and on cooling becomes a mass of crystals. At a high temperature it decomposes, giving rise to an abundance of ammoniacal products. It burns without leaving any residue. The salts crystallise with difficulty. The hydrochlorate crystallises best and quickest. Chloride of gold forms with it crystalline plates which when heated develope benzoic acid. Cocaine does not act on the pupil, and by this and the foregoing chemical test it is distinguished from atropine which it resembles in many other respects. It is prepared in the following way. The leaves of the coca are digested with alcohol acidulated with sulphuric acid: the tincture is filtered and then treated with slaked lime which precipitates some of the chlorophyll and some waxy matter. The liquid is then neutralised with sulphuric acid and evaporated in a water bath. The residue treated with water deposits the rest of the chlorophyll and becomes of a brown colour. The liquid contains the sulphate of cocaine from which the alkaloid is precipitated by carbonate of soda. The precipitate is treated with ether to take up the cocaine, which is purified by several crystallisations from alcohol. This alkaloid might perhaps be found very useful in medicine.

Œnanthic Acid. — M. Fischer announces[4] his belief that there is no such a body as œnanthic acid, and that the liquid to which the name has been given is a mixture of capric and caprylic acids.

Preparation of Nitro-benzine with Oil of Turpentine.—When oil of turpentine is acted on by strong nitric acid, a resinous substance and an orange-coloured liquid are obtained. When both these are evaporated together there is formed a yellow residue, and if this be mixed with sand and submitted to dry distillation, the products are an oily fluid and a strongly acid liquor. According to Schiff[5] the oily fluid when redistilled yields nitro-benzine between 200° and 210°. The author has convinced himself of its identity by preparing aniline with it by means of zinc and hydrochloric acid.

III. ANALYTICAL CHEMISTRY.

Estimation of Nitrogen by Soda Lime.—M. Bouis proposes[6] to replace the mixture of oxalic acid and soda lime put at the end of the combustion tube with oxalate of lime dried rapidly at 110°. This salt has the advantage of being anhydrous, while the crystals of oxalic acid contain 43 per cent. of water, and so it often happens that when the mixture is heated the tube is broken and the analysis lost. Besides this the oxalic acid of commerce often contains ammonia, and if it be purified it is difficult to keep it long in a state of purity.

The author also points out that the proportions of soda and lime must not be varied at the taste of every chemist: a mixture of one part of soda and three parts of lime alone gives exact results.

He further states that it is not necessary to pass a current of steam through the tube when anhydrous cyanides are analysed, as some chemists have supposed.

Lastly, he states that there is no danger of the ammonia which is found in these estimations being decomposed by

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[1] *Journ. f. Prakt. Chem.* Bd. lxxix. s. 121; *Polytch. Journ.* Bd. clv. s. 465.
[2] *Annal. der Chem. und Pharm.* Bd. cxiv. s. 260.
[3] *Archiv de Pharm.* Bd. cii. s. 29.
[4] *Comptes-Rendus*, t. li. p. 104.
[5] *Annal. der Chem. und Pharm.* Bd. cxiv. s. 201.
[6] *Journal de Pharm. und Chem.* t. xxxvii. p. 266.

passing over the soda lime; for he has passed this alkali through long tubes filled with soda lime and strongly heated, and even over red-hot lime, without observing any decomposition.

Separation of Alkaloids from Extracts and Tinctures. — Gundermann describes[7] a process (which, however, we believe is known to most of our readers) for estimating the value of extracts by separating their alkaloids by means of chloroform. The extract is mixed with a small quantity of water and then digested with four times the volume of chloroform for some days, the mixture being shaken from time to time. The chloroform solution is then separated and evaporated. The residue is treated with acidulated water, and the alkaloid is precipitated by means of ammonia. Tinctures submitted by this process must first be evaporated to a syrupy consistence.

MISCELLANEOUS.

Italian "Cachou Aromatique."—

Extract of liquorice, by infusion	100	grammes.
Water	100	„
Dissolve in water bath, and add		
Powdered catechu	30	„
Powdered gum	30	„
Evaporate to the consistence of an extract, and then incorporate the following substances, reduced to powder :—		
Mastic	2	grammes.
Cascarilla	2	„
Charcoal	2	„
Orris root	2	„
Concentrate the mass, remove it from the fire, and then add		
Oil of peppermint	2	grammes.
Tincture of musk	5	drops.
Tincture of amber	5	„

Pour it on a marble, previously oiled, and roll it (by means of a roller) to the thickness of refined juice. When the mass is cold remove the oil from both surfaces by means of unsized paper; moisten it slightly, cover it with silver paper, let it dry, and then cut it into narrow strips, and divide these into minute squares or lozenges.

This preparation, much used by smokers to destroy the smell of tobacco, is also a stomachic and carminative of a very pleasant flavour.—*Bulletin de Thérapeutique.*

The Atlantic Cable.—The Atlantic cable, it seems, is irrecoverably lost. A report has been received from Messrs. Varley and Kell which informs us that the portions they have been able to raise are so much injured as to be quite worthless. The cable was frequently hooked by the grapnel, but generally broke before it could be seized. Some portions, however, were recovered, and the following quotation from the report explains its condition :—

"The recovered cable varied in condition very much, and what is most important is, that even those portions which came out of the black mud were so perished in numerous patches that the outer covering parted on board during the process of hauling in, and but for the dexterity and courage of the men in seizing hold of it beyond the break where the iron wires stuck out like bunches of highly sharpened needle points, we should not have known so much of its condition. In a word, it was evidently sometimes embedded in mud, sometimes on small stones, sometimes half embedded, and sometimes wholly exposed over rocks, as was apparent from the condition of the outer covering.

"The iron wires in many places often appeared sound, but on minute inspection were found eaten away and rotten; the serving was also decayed. In some places the iron wires were coated with metallic copper, and much eaten, they having most probably rested upon copper ore, for there are veins of it in Trinity Bay. The gutta percha and copper wire are, however, in as good condition as when laid down."

Some very useful knowledge has, however, been gained by this costly experiment :—

"Those portions of the recovered cable that were wrapped with tarred yarn were sound, the tar and hemp having preserved the iron wires bright and free from rust. This will be further reported on when the pieces of recovered cable have been more closely examined."

This determines the sort of cable to be used in any future undertaking, and will probably lead to the general adoption of ropes similar to that which has been laid between Toulon and Algiers.

Silvering Lead Tubing. — Mr. John Matthews, of New York, has just taken out a patent for the above. Many attempts have been hitherto made to silver the interior of lead and other tubing employed in mineral water apparatus and for other purposes, by the voltaic process, but it has hitherto been found impossible to effect a uniform deposition of the silver throughout the whole length, or even to obtain any deposition beyond a short distance from the ends of the tubing. The object of this invention is to obtain by such process a uniform deposition of the silver on every part of the interior of a piece of tubing of any length, and to this end the invention consists in the employment as the bath or decomposition cell of the tube itself; also in the use, for the purpose of conducting the galvanic current and for replenishing the supply of the coating metal, of a rod or wire passing through the tube in the direction of its length; also in the extension or stretching of the tube and central conductor by means of screw threads and nuts, or their equivalents attached to their ends, for the purpose of keeping them straight, and thereby providing for the more ready insertion of the central conductor within the tube, and for the prevention of metallic contact; also in the use of non-conducting supports between the interior of the tube and the exterior of the central conductor, for the purpose of preventing the conductor coming in contact with the tube, and preserving a uniform distance between them in all parts; also in providing for the movement of the central conductor and its non-conducting supports within the tube to permit the deposition of the metal on all parts of the interior of the lead pipe, which could not take place if the supports were stationary; and lastly in connecting the poles of the battery at opposite ends of the tube and central conductor to insure uniformity of deposit throughout the whole length of the tube.

[7] *Archiv de Pharm.* Bd. cli. s. 43.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A Reader.—Bowman's *Practical Chemistry.*

J. C. S.—We are obliged to our correspondent for his communication. One more lecture will conclude the course, and then the publication of those mentioned will be resumed.

R. E.—The change noticed by our correspondent is a well known fact.

A. H.—Dr. Unger resides at Manchester. We do not know the exact address.

A Friend in Need.—Four cells of Grove's or Bunsen's are necessary. The temperature must be high enough to keep the compound well fused, the higher the better.

Communications received from—*C. J. S.*—*T. S.*' *Barrett* — *William Crossley.*

Books received—Braithwaite's *Retrospect. Transactions of the Philosophical Society of Manchester.*

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THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Quantitative Separation of Cobalt and Nickel from their Ores and from each other, by E. ASH HADOW.

As the constituents of a cobalt or nickel ore handed for analysis may be of the most varied description, it is necessary, before attempting to effect a complete separation and estimation of these two metals, either to begin with a careful qualitative analysis, and then to select such methods as are recommended in works on analysis for the separation of each foreign constituent, which would often involve a number of distinct troublesome processes not fitting conveniently one into the other, or else to be in possession of a method so generally applicable as to be capable of effectually eliminating nickel and cobalt from all other elements, and at the same time so simple that even if certain elements, which it is especially designed to separate, should happen not to be present, it would cause no unnecessary waste of time. Such methods doubtless many have, but not having met with one in works on analysis generally applicable to all descriptions of ores of these metals, I make the following communication in the hope that it may prove serviceable to some who have experienced the difficulties which attend the separation of these metals, and have not yet been successful in overcoming them, and also with the view of suggesting a method by which the cobalt constantly contained in the ores of manganese might easily and profitably be rescued from the waste manganese solutions of the bleaching powder works, an application of the method, for which I am indebted to Mr. Bloxam.

If no qualitative analysis of the ore has been previously made, we must presume, in the quantitative separation of cobalt and nickel, that all other common elements are present; attention, however, need only be specially given to those elements, or their compounds, of which the separation is particularly difficult; these are iron, manganese, zinc, alumina, magnesia, lime, soluble silica, arsenic, and phosphoric acids. By employing however the method usually applied to the separation of phosphoric acid for the removal of iron, arsenic and alumina, and one of the methods recommended for the separation of manganese from cobalt, for the removal likewise of magnesia, lime, soluble silica and the last traces of alumina, and by a slight modification for the detection and separation of zinc, the analysis becomes short, easy, and accurate.

The only examination which the ore need undergo previously to the solution of a weighed quantity, is with the view of obtaining a rough idea as to the amount of arsenic, and cobalt or nickel present in the sample; for this purpose a little may be roasted on charcoal, or ignited in a tube, to see whether arsenic readily sublimes; another portion of a few grains weight may be dissolved in aqua regia in a test tube, when the depth of the blue or green colour will serve as an indication of the degree of richness of the ore in cobalt and nickel.

If the ore is rich, from 20 to 30 grains; if poor, from 50 to 100 grains, in a state of fine division, are weighed out for the analysis. If much arsenic has been found, the portion, after weighing, had better be ignited in a small porcelain capsule or crucible over a gauze burner, when it generally ignites and smoulders away, evolving abundance of arsenious acid. The powder ready for solution is transferred to a small 4-oz. flask by means of glazed letter paper and a camel's-hair paint brush to sweep in the last particles; the mouth of the flask is then partially closed by a small funnel placed to catch the drops projected during solution. The ore is then drenched with hydrochloric acid, nitric acid being added from time to time, until all heavy metallic-looking particles are found to have disappeared from the bottom of the flask. The solution may then be decanted from the insoluble matters into a half-pint beaker, together with the washings of the flask, and as sulphur frequently remains, entangling portions of undissolved ore, it is advisable to transfer the undissolved residue from the flask into a capsule, drying and igniting the contents of the latter, and then digesting again the ignited matters in a little more aqua regia; the whole of the latter, both dissolved and undissolved, may now be added to the first portion in the half-pint beaker.

To separate out from the solution iron, arsenic, phosphoric acid, and alumina, acetate of soda may be added at once, and the liquid boiled; a far better mode, however, is to effect a *partial* separation of these ingredients by the addition of carbonate of lime in excess to the solution of the ore, and after filtering out the solution containing the greater portion of the cobalt and nickel, and partly washing the precipitate, to extract the last traces of cobalt and nickel from the latter by dissolving it in hydrochloric acid, adding excess of acetate of soda, and boiling. The first filtrate from the precipitate by carbonate of lime had better be collected apart from the second filtrate from the precipitate produced by acetate of soda, and received in a beaker capable of holding at least a quart. The solution of the precipitate by carbonate of lime is best effected in a beaker, after the removal of the precipitate from the filter, which is easily effected by inclining the funnel over the beaker and sending a stream of water from the wash-bottle between the filter and the upper edge of the mass of precipitate, when the latter will soon become detached and slide off into the beaker below; it is here treated with dilute hydrochloric acid, to dissolve all but the insoluble residues of the ore which had not been previously filtered off, and then a solution of acetate of soda is added in excess (indicated by the deep red colour of liquid), and the whole, heated to boiling, may be filtered at once. Iron thus separated out, in presence of free acetic acid, has less tendency to retain cobalt than when precipitated by means of carbonate of lime, besides which the cobalt and nickel in the filtrate are left in the condition of acetates, a necessary step, preparatory to their separation from manganese, &c. This method of separating out iron, &c. though very effectual, was

often at first found to be attended with difficulties, for if much arsenic were not present the basic acetate of iron frequently became slimy towards the end of the filtration, only allowing the boiling washing water to pass with such extreme slowness, as to render the method almost useless, until it was found that the addition of a little sulphate of soda during the washing at once and permanently effected a cure, causing filtration to proceed rapidly, and diminishing the tendency of the iron to pass the filter; another difficulty was, that when acetate of soda was added at once to the original solution of the ore, the solution containing often much cobalt and nickel as acetates, and filtered in a concentrated state, yielded to the filter paper sufficient cobalt and nickel to occasion distinct loss; this was avoided by separating out the great bulk of the cobalt and nickel in solution as chlorides by means of carbonate of lime, as above recommended, and then the weaker solution, being comparatively strongly acid, could be filtered without loss. This second filtrate may still retain traces of iron; a little acetate of soda may be added to make sure that none remains in the condition of chloride, which would be indicated at once by a reddening of the liquid, and the whole is then boiled thoroughly once more, and if rendered at all turbid passed through a filter again, then nearly neutralised with ammonia, and finally added to the bulk of the cobalt and nickel solution in the quart beaker. There will in all probability be enough of the acetates of soda and ammonia present to convert the entire quantity of cobalt and nickel into acetates without further addition, and rendering it thus ready for the next operation.

If sulphuretted hydrogen be now transmitted through the solution containing cobalt and nickel, these metals are perfectly and completely separated without a trace of manganese, magnesia, lime, alumina, or soluble silica, which when present invariably accompany the sulphurets precipitated by hydrosulphate of ammonia; the sulphurets, moreover, thus precipitated from an acetic solution, have greatly less tendency to oxidise while on the filter, so that their washing may be more perfectly accomplished than in the former case. The passage of sulphuretted hydrogen may be conveniently effected at the end of the day, and the next morning the sulphurets will be found perfectly settled at the bottom of the beaker, permitting the great bulk of the liquid (tested first to make sure of the removal of cobalt and nickel) to be drawn off and thrown away, or at least rapidly run through a filter; the sulphurets collected at the bottom, together with that which always adheres to the sides of the beaker, and which may be detached without loss by a caoutchouc-covered glass rod, are then well washed on the filter with boiling water until all soluble matters are perfectly removed. The sulphurets, perfectly washed, are now to be dried by placing the funnel with the filter in a broken beaker on wire gauze, at a safe distance over a lamp, and when dry they may be detached from the filter into a small beaker of from 1 to 2 oz. capacity, capable of being covered with a watch glass; the filter itself is ignited, and the well burnt ashes added to the sulphurets, which are then *cautiously* to be treated with nitric acid, the action being rather violent, and if care be not taken liable to occasion loss. With the aid of a little heat the whole should pass into solution. In addition to cobalt and nickel the solution may still contain zinc, together with copper, and other metals precipitable by sulphuretted hydrogen from hydro-chloric solutions; by passing sulphuretted hydrogen now through the nitric solution, somewhat diluted, these latter are readily precipitated and removed by filtration. Zinc however may still remain, to detect and remove which it is necessary to expel the sulphuretted hydrogen still remaining in the solution by boiling, to add solution of ammonia until a precipitate occurs, and then to acidify pretty strongly with acetic acid; if sulphuretted hydrogen slowly transmitted, or fresh sulphuretted hydrogen water, occasions a milkiness, zinc is present, and the slow passage of the gas is to be continued until the precipitate begins to show signs of darkening. The liquid is then filtered. The zinc may be identified as such by collecting and igniting the precipitate, when a trace of cobalt carried down with it (and which may be separated out, if desired, by a repetition of the process on the precipitate) will produce the beautiful and well known Rinman's green. The filtrate containing only nickel, cobalt, and salts of ammonia, is treated with some pure sulphuric acid and evaporated to dryness in a weighed capsule, and heated sufficiently to expel the excess of sulphuric acid and all the ammoniacal salts. The residual sulphates of cobalt and nickel may now be weighed in a covered crucible. This form of weighing these metals is easy, exact, and may be rapidly executed. The weight of the ash of a filter of the size used for collecting the sulphurets must be ascertained after treatment with sulphuric acid, and subsequent expulsion of the excess, and this weight deducted from the total sulphates, in order to obtain perfectly correct results.

If it be desired to weigh these metals as oxides, pure potash or carbonate of soda must be substituted for ammonia, with acetic acid for the removal of zinc, and after the precipitation of the latter the filtrate must be first acidified with hydrochloric acid and boiled to expel sulphuretted hydrogen, and finally supersaturated with potash; the precipitate thus obtained is however difficult to wash, and almost always contains some silica derived from the potash, or the vessel in which the operation was conducted, and is not to be recommended as so convenient or exact a form as that of the sulphate. After ignition of the oxides, the nickel exists as NiO, and the cobalt as Co_3O_4.

Binoxalate of potash serves as a perfect precipitant of nickel, but cobalt is not so thoroughly separated; the first goes down as a double salt of nickel and potash, the latter as a simple oxalate; both precipitates are very easily washed, and give perfectly correct results with nickel, nearly correct with cobalt; the former precipitate must, after ignition in an open crucible, be washed with a little water to remove the carbonate of potash, and again dried and weighed as oxide, NiO, the oxalate of cobalt strongly ignited in the open air leaves the oxide Co_3O_4.

It now only remains to separate the nickel and cobalt from each other. If the colour of the solution indicates that the latter is in excess, Liebig's method of separation by converting the metals into double cyanides is probably preferable to any other, perfectly correct results are, however, only attained when certain precautions are taken; in the first place it is not altogether a matter of indifference whether the mixed sulphates or the oxides brought into solution in hydrochloric acid be treated with potash, or with hydrocyanic acid, first, unless indeed the potash be perfectly free from silica; if the latter be present, and the potash is added first, the precipitate produced frequently refuses wholly to dissolve on the addition of hydrocyanic, and though liable to be disregarded, from making little show in the coloured liquid, it will, if filtered off, be found to retain cobalt. Therefore hydrocyanic acid should always be added first, and

the subsequent addition of potash will then produce perfect solution, even though silica should be abundantly present in the potash, a condition which is, however, to be avoided, as the silica will afterwards attach itself to the nickel precipitate. The most important point to be attended to is the complete conversion of the cobaltous- into the cobaltid-cyanide, a change which is effected by the absorption of oxygen from the air, which takes place with great rapidity, but still not so rapidly, but that by the hasty addition of oxide of mercury a considerable quantity of cobalt might be precipitated with the nickel. The change from the absorption of oxygen is easily seen if the solution is cold, by the liquid at first, of a deep yellowish green, becoming rapidly, from the surface downwards, of a deep reddish brown, which changes to pale yellow when warmed. There is no need of *free* hydrocyanic acid, neither can any hydrogen be observed to escape on boiling the solution of a cobaltouscyanide. The composition of the cobaltouscyanide does not appear to have been ascertained, but supposing it, as is most probable, to resemble the ferrocyanide, the change effected by the air will be,—

$$2(K_2Cy_2.CoCy) + O = K_3Co_2Cy_6 + KO$$

The nature of the change from dark brown to yellow on warming the solution is not quite intelligible, but from its rapidity it appears to be merely some molecular rearrangement, similar to that which may be observed when an acid saturated in the cold with fresh hydrated oxide of iron and of a deep red colour becomes bright yellow on gently warming. When the change from cobaltous- into cobaltid-cyanide is complete (which may be ascertained by withdrawing the source of heat and observing whether the cooling liquid continues to remain of a pale yellow colour) the nickel may be precipitated either as pale hydrated protoxide by the addition of precipitated oxide of mercury, or as the black hydrated sesquioxide by means of chlorine or chloride of soda. The latter appears to be the best of the two methods for the following reasons:—1st. That it serves as a qualitative test in the first instance for the presence of nickel, the *least trace* of the sesquioxide giving an inkiness to the liquid, whereas when oxide of mercury is used the excess of oxide of mercury completely disguises a small quantity of the pale green protoxide of nickel, which can only be detected after washing and igniting the precipitate. 2nd. The hydrated protoxide separated by oxide of mercury may easily carry down some cobalt as cobaltidcyanide of nickel unless the liquid is strongly alkaline, which is not the case with the sesquioxide, even when precipitated from liquids nearly neutral. 3rd. The first action of the chlorine, or chloride of soda, is upon the cobaltouscyanide, effectually ensuring its conversion into cobaltidcyanide, before the cyanide of nickel is touched. 4th. The sesquioxide of nickel is washed with far greater ease and rapidity than the protoxide. The action of chlorine upon the cobaltouscyanide and nickelouscyanide, which at first exist together in the solution may be thus represented:—

$$2(K_2Cy_2.CoCy) + Cl = K_3Co_2Cy_6 + KCl$$

When this change is complete the chlorine, unable further to act upon the cobaltcyanide, attacks the nickelcyanide thus, with the *aid of a large excess of alkali*.

$$2(NiCy.KCy) + 11KO + 9Cl + 3HO = Ni_2O_2.3HO + 4KOCyO + 9KCl$$

If potash is used it must be pure and free from silica and alumina, hence, for the sake of economy, carbonate of soda may be substituted for it, the carbonic acid escaping with effervescence on the passage of chlorine into the boiling liquid. A more convenient way perhaps is to add to the boiling solution of the cyanides, a previously prepared solution of chloride of soda containing excess of carbonate of soda as long as it continues to produce a precipitate.

If the separation of nickel by oxide of mercury be preferred, a solution of a salt of mercury may be substituted for the previously prepared oxide with advantage as regards economy, rapidity, and neatness; the excess of alkali in the liquid produces a momentary precipitation of oxide of mercury with each drop added, until the nickelouscyanide has been wholly decomposed, when the yellow colour of the oxide of mercury appears permanently. With a solution of corrosive sublimate the change is as follows:—

$$NiCy.KCy + xKO + 2HgCl = NiO + 2HgCy + 2KCl + (x-1)KO$$

If it be desired to weigh the cobalt of the cobaltidcyanide after the separation of the nickel, by Wöhler's method of precipitating the solution with nitrate of the suboxide of mercury, chlorides and sulphates are to be avoided as giving rise to very bulky precipitates; and accordingly after the separation of zinc the nickel and cobalt should be precipitated by potash, brought into solution in nitric acid, and after conversion into cyanides, nitrate of protoxide of mercury may be used to separate out nickel. In washing the cobaltidcyanide of the suboxide of mercury, its disagreeable tendency to pass through the filter towards the conclusion of the washing may be effectually prevented by adding a little nitrate of suboxide of mercury to the washing water.

If the colour of the solution of the mixed oxides indicates that nickel is decidedly in excess, it will be better before proceeding to separate out the cobalt by Liebig's method, to concentrate the cobalt by a previous partial separation by a method which Mr. Merry of Swansea employs to effect a complete and entire separation of the two metals, it is a modification of Rose's method for their separation, and consists in adding to the perfectly neutral solutions of the two, a solution of chloride of lime as long as it produces an immediate black precipitate. To extract the last traces of cobalt the addition of chloride of lime must be carried somewhat beyond this, since a black precipitate forming even after some minutes often contains a trace of cobalt; if there be much of the latter the liquid must be neutralised from time to time with lime water, or milk of lime.

$$2CoCl + 3CaOCl + 2CaO = Co_2O_3 + 5CaCl$$

The black precipitate containing all the cobalt with some nickel can then be brought into solution, and the cobalt separated out either by Liebig's method, or by a repetition of the above process.

This method is a very useful one for detecting the *smallest trace* of cobalt in a solution of nickel, the solution digested in the cold on carbonate of lime to render it neutral, is filtered and treated with a few drops of a solution of chloride of lime; if cobalt is present to a certain extent an immediate brown cloud is perceived, but if far less than this the dark precipitate which will form after some time will certainly contain cobalt, if any be present, and on dissolving in borax will become manifest, if not at once, at least when the nickel has been reduced by ignition on charcoal before the blowpipe, by the blue colour of the lead.

The property which cobalt possesses of being perfectly precipitated from its acetic solution by sulphuretted hydrogen, and thus of being separated from manganese

might probably be profitably employed to rescue the cobalt which is contained in the solutions of manganese from the bleaching powder works. All that is necessary is to add to the liquid an excess of chalk, which would remove all the iron and render the liquid neutral, the latter drawn off from the precipitate would merely require the addition of a very little acetate of soda, about ninety parts of the dried salt to every forty of the commercial oxide of cobalt in the liquid (which would have to be determined by a separate examination of a portion), and then sulphuretted hydrogen transmitted would precipitate all the cobalt as sulphuret at once.

On the Melting-points of some of the Elements, by William Crossley, *Assay Master, Ormesby Ironworks, Middlesborough.*

It is remarkable that in almost all the series or groups of the elements mentioned by Mr. Coleman there appears to exist a peculiar relation between the atomic weight and the melting-point, which to a certain extent confirms his opinion that the equivalent number of an element expresses a certain amount of force, modified by its atomic volume. As an illustration we will take the group zinc, palladium, platinum.

	At. Weight.	At. Vol.	Melting-Point.
Zinc	33	57	773° F.
Palladium	53	57	Highest heat of wind furnace.
Platinum	98	57	Oxyhydrogen blowpipe.

Here we have a group of elements having a like atomic volume with an increasing atomic weight, not only decreasing in active chemical attraction, but decreasing in fusibility as the weight of the atom increase. Does the atomic weight here represent a force? We think so, because it appears general. Let us pass on to some other groups.

	At. Weight.	At. Vol.	Melting-Point.
Sulphur (crystallised)	16	101	239° F.
Selenium	40	101	420° F.
Lead	103·7	114	617° F.
Silver	108	128	1873° F.
Gold	197	128	2016° F.
Chlorine (liquid)	35·5	320	Gaseous at com. temp.
Bromine	80	320	Liquid do.
Iodine	127	320	Solid do.
Aluminium	14	66	Red heat.
Chromium	27	66	Agglomerate but not fuse at highest heat of wind furn.
Molybdenum	46	66	
Tungsten	95	66	

Here we have four groups, in each of which the elements having the least atomic weight offer the least resistance, not only to the action of other elements, but also of heat. In so many groups, taken as it were at random, it cannot all be accident. There are, however, exceptions: we find them in the groups

	At. Weight.	At. Vol.	Melting-Point.
Manganese	27·6	44	Highest *heat* of wind furn.
Iron	28	44	" "
Cobalt	29	44	" "
Nickel	29	44	" "
Copper	32	44	1996° F.
Phosphorus	32	211	111° F.
Anthmony	129	224	Red heat.
Bismuth	213	270	507° F.

Manganese and iron and perhaps cobalt and nickel follow this law, but copper varies very much: for this we can see no reason. Phosphorus and antimony follow the law, but bismuth comes between. What can influence it? Look at its atomic volume; it differs 59 from that of phosphorus. We cannot, therefore, be much surprised at its having a different melting-point.

These facts support Mr. Coleman's views. The subject is interesting and well worth discussing.

On some New Volatile Alkaloids given off during Putrefaction, by F. Crace Calvert, *Ph.D. F.R.S. &c.*

Some eighteen months ago my friend, Mr. J. A. Ransome, surgeon to the Royal Infirmary, Manchester, induced me to make some researches with the view of ascertaining the nature of the products given off from putrid wounds, and more especially in the hope of throwing some light upon the contagion known as hospital gangrene. I fitted up some apparatus to condense the noxious products from such wounds, but the quantity obtained was so small that it was necessary for me to acquire a more general knowledge of the various substances produced during the putrefaction of animal matter, before I could determine the nature of the products from sloughing wounds. I therefore began a series of experiments, the general results of which I now wish to lay before the Society.

Into each of a number of small barrels twenty lbs. of meat and fish were introduced, and, to prevent the clotting together of the mass, it was mixed layer by layer with pumice-stone. The top of each barrel was perforated in two places, one hole being for the purpose of admitting air, whilst through the other a tube was passed which reached to the bottom of the barrel. This tube was put in connexion with two bottles containing chloride of platinum, and these in their turn connected with an aspirator. By this arrangement air was made to circulate through the casks, so as to become charged with the products of putrefaction, and to convey them to the platinum salt. A yellow amorphous precipitate soon appeared, which was collected, washed with water and alcohol, and dried. This precipitate was found to contain C, H, and N, but, what is highly remarkable, sulphur and phosphorus enter into its composition. The presence of C, H, and N was ascertained by elementary analysis; for the sulphur and phosphorus, a given weight of the platinum salt, 0·547 grm. was oxidised with nitric acid, and gave 0·458 grm. of sulphate of baryta =11 per cent. of sulphur, and 0·266 of pyrophosphate of magnesia = 6·01 per cent. of phosphorus. I also ascertained the presence of these two substances by heating a certain quantity of the platinum salt with strong caustic ley, when a liquid volatile and inflammable alkaloid was obtained, whilst the sulphur[1] and phosphorus remained combined with the alkali, and were easily detected. I satisfied myself during these researches, which have lasted more than twelve months, that no sulphuretted nor phosphuretted hydrogen was given off; and my researches, as far as they have proceeded, tend to prove that the noxious vapours given off during putrefaction contain the N, S, and Ph of the animal substance, and that these elements are not liberated in the simple form of ammonia and sulphuretted and phosphuretted hydrogen. I also remarked during this investigation that

[1] Some of the platinum salt was treated with CS_2, which did not remove any free S, and the beautiful orange-yellow colour of the precipitate showed the absence of sulphuret of platinum.

as putrefaction proceeds different volatile bodies are given off.

Before concluding, I may add, that when the platinum salts are heated in small test tubes they give off vapours, some acid and some alkaline, possessing a most obnoxious and sickening odour, very like the odours of putrefaction, and that at the same time a white crystalline sublimate, which is not chloride of ammonium, is formed.

As I foresee that these researches will occupy several years, I have deemed it my duty in the meantime to lay the above facts before the society.—*Proceedings of the Royal Society.*

TECHNICAL CHEMISTRY.

On Aniline Blue, by M. Kœchlin.

If hypochlorite of lime be added to a solution of aniline in a strong acid with the acid in excess, and the acid is afterwards neutralised with an alkali, a blue colour is produced.

Chromic acid added to a solution of aniline in hydrochloric acid gives a red, a violet, or a blue, according to the proportion of the acid.

Thus:—

1 lit.[1] anil.	+ 0·5 lit. hyd. ac.	+ 80 grm. chromate	gives	reddish		
1 „	+ 0·75	„	+ 80	„	„	„
1 „	+ 1·0	„	+ 80	„	„	violet
1 „	+ 1·5	„	+ 80	„	„	blue
1 „	+ 2·0	„	+ 80	„	„	„

If the last two mixtures be neutralised with lime, blue solutions with an alkaline reaction are formed. When protected from the air the blue colour changes to a greenish tint; but the blue is restored on exposure. It is reddened by an acid. In these two characters it resembles litmus.

PHARMACY, TOXICOLOGY, &c.

On Liquor Ferri Iodidi, and on a New Compound of Iodine and Sugar, by E. Fougera, *Pharmaceutist.*

The numberless formulas proposed every day by pharmaceutists and manufacturing chemists are a sufficient proof of the difficulty of preserving the iodide of iron free of decomposition, and also of the non-success of the previous recipes.

Every chemist is aware that in chemical combination a change of temperature will sometimes change the nature of a product. Such may be the case in the preparation of this ferruginous salt.

From all my experiments I have come to the conclusion:—

1st. That glycerin has very little, if any, superiority over sugar for the preservation of the ferruginous liquor.

2nd. That the liquor ferri iodidi freshly made, or already undergoing decomposition, becomes entirely unchangeable by a long exposure to heat or to the rays of the sun, even if the bottle afterwards be but partly filled and kept in a dark place. The same result is also obtained by the addition of a few drops of tincture of iodine to the ordinary liquor, and exposure to the heat and sun as above. In proof of this I have two small bottles, which have served me in my experiments, the one labelled made October 3, 1857, the other, June 3, 1858; both were exposed to the rays of the sun till January 4, 1859, when they were taken into the cellar and left there ever since.

3rd. That iodine forms with sugar a chemical combination, as it is explained below.

4th. That the liquor of iodide of iron is improved, and rendered more perfect by exposure to the rays of the sun.

I will here mention a formula which I have used for some time with satisfaction; it consists in introducing 4 oz. crushed sugar into a Florence flask along with the water, iodine, and iron; when the salt of iron is formed, which is known, as usual, by the light green colour of the liquor, it is filtered over the remaining 8 oz. of sugar, boiled and strained, as any other syrup. This process of adding a part of the sugar to the first operation has the advantage of furnishing a sweetened green solution, which can be filtered with as much ease as simple water, without fear of any decomposition.

However good the above formula may be, I have abandoned it for the following:—

Liquor Ferri Iodidi.

℞ Iodini sublimat.	℥ij.
Pulv. Ferri puri	℥v.
Sacchari Albi	℥xij.
Aquæ destillatæ	q. s. vel. ℥xiv.

Ut fiat solutio secundum artem.

The iodine is weighed separately in a wide mouth bottle, perfectly dry; all of the iron and about 6 oz. of water, more or less, makes no difference, is introduced into an ordinary bottle, and the iodine added in small quantities (one to two drachms), adding a new portion only when the previous one is combined to the iron. As soon as a portion of iodine is thrown into the iron water, the operator is to shake the bottle continuously until the metalloid is combined with the metal; and to avoid the elevation of temperature during the chemical combination the bottle must be shaken under a stream of cold water, or in a tub of ice water.

When all of the iodine is combined with the iron, which requires only half an hour, the light green solution is filtered, and the filter washed with a sufficient quantity of water to make the liquid measure 12 oz. fluid. To this the sugar is added, the whole raised to the boiling point, and strained. When cold, 20 oz. fluid must be completed with some water; then the liquor is put in a lbj. or 4 oz. bottle, according to the sale. The filtration requires no more than ordinary care, no decomposition takes place, and none of the salt is left on the filter, on which remains only a small portion of the excess of the metallic iron.

The liquor thus made can be kept free of decomposition, in filled bottles, either in the light or in the dark. When the bottles are not full, if kept in the dark, the liquor, after a while, becomes slightly yellowish; but if exposed in a warm place, or to the rays of the sun, its beautiful light green colour is restored, and invariably maintained if kept so long enough.

When liquor ferri iodidi is undergoing decomposition, I have ascertained that the decomposition stops at a certain point, and goes no farther, even when placed in an evaporating dish, simply covered with a piece of paper, and left in the dark. Why is this?

Again, when this same preparation, with or without an excess of iodine, is exposed a certain length of time to the heat or to the rays of the sun, it permanently keeps its light greenish colour. Why is this also?

At present I am not fully prepared to answer these

[1] 1 litre = 1¾ imp. pint. 80 grammes = 2 oz. 4 drs. 40 grains, troy.

two questions, but I may take another opportunity for doing so. However, I may be allowed to say here, that the old theory of the decomposition of iodide of iron, first into protoxide of iron and hydriodic acid by the decomposition of water, and afterwards the transformation of the proto into the sesquioxide by the oxygen of the air, cannot be admitted here, except *perhaps* when the iodide of iron is in a purely aqueous solution. But granting the correctness of the theory, we would ask why decomposition does not continue indefinitely in saccharine solutions of iodide of iron, until the whole of it is decomposed into sesquioxide of iron and hydriodic acid?

I will here state a fact that I have nowhere seen mentioned, and which I can prove beyond a doubt, it is that iodine unites with sugar to form a chemical combination, which I will call *iodide* of *sugar*.

This new therapeutic agent, as white and as agreeable to the taste as the simple syrup, stable in its composition, no doubt will some day take the lead among the preparations of iodine. This metalloid, however, has but a slight affinity for sugar, but, that they do unite together, I think is proved.

From this fact I draw the inference that the sugar, which is the very substance that preserves the iodide of iron intact, is also the cause of its decomposition to a certain point; and from it I deduce my theory, which is, that in the liquor ferri iodidi the sugar by affinity decomposes a small portion of the iodine and protoxide of iron, and when this liquor is warmed or exposed to the sun's rays the iodine combines with the sugar to form iodide of sugar, and the protoxide of iron probably combines also with the sugar, or dissolves in the syrup, so as to form a syrup of protoxide of iron.

In the other instance, when to a newly made liquor a slight excess of iodine is added, and the whole exposed to the heat as above, the sugar combines with that small portion of iodine, and its affinity for the metalloid is lessened so much that it has no more power to decompose the iodide of iron, which will therefore remain permanent.

These two assertions prove conclusively also that there can be no iodate of iron formed, as has been advanced by some, and that this ferruginous liquor can, and ought to be, kept in the sun's light.

Foreign Pharmacy.

New Remedy for Tape Worm.—Dr. Tarneau has had great success in expelling *tenia* by the use of *pumpkin seeds*. Forty grammes of these are pounded in a mortar with a little sugar, and water is added to make an emulsion, which is taken early in the morning, and is followed in two hours by a dose of castor oil. It is recommended that the patient should be placed on a low diet the day before the remedy is employed.

Stearate of Iron.—This remedy has been found very useful by Ricord in the treatment of the sores with which his name is particularly associated. Some perhaps may wish to give it a trial in this country, so we extract the formula for its preparation:—

Take of Sulphate of iron one part,
„ Hard soap two parts.

Dissolve them separately in about three times the weight of water, and mix the solutions. A greenish precipitate is the result, which is separated and dried, and then melted by a gentle heat. When melted it is spread on cloth like an ordinary plaster.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On recent Researches in Physical Geography and Geology, by D. T. Ansted, *Esq. M.A. F.R.S.*

Lecture III. *Central Africa and Central Australia.*

(*Concluded from page* 81.)

I must now say a few words to point out the way that this discovery came about. It is an interesting and eventful history, but I must pass very rapidly over the discoveries, taking them in groups in the way they are marked in the outline maps:—1 following the course of the Nile to Abyssinia, and proceeding from the shores of the Red Sea to the sources of the Nile; 2 is parallel to the Nile to the east. The 3rd group is at right angles to these, running westward; 4 runs southwards from Tripoli to Lake Tsad; 5 southwards, west of 4, and connects Lake Tsad with Timbuctu; 6, 7, and 8 refer to the country between Senegal, Timbuctu, the mouth of the Niger and Tangier; 9 runs in east from the coast to Lake Ngami; and 10 is the course taken by Livingstone from the Cape and Natal to Loando, and thence down the Zambesi to its mouth; 11 is the trip from Zanzibar to the great lakes visited by Burton and Speke; 12 is the last group, showing the direction travelled by the German missionaries Krapf and Rebmann. I shall first of all consider the groups in the neighbourhood of Cairo. The Nile began to be known when, in 1768, Bruce was first induced to look for its sources. These sources were assumed to be in Abyssinia, and from the cataracts to the sources is was hardly more than guessed at. Bruce, with enormous suffering in many respects, reached the sources of the Nile in Abyssinia, but these are only the tributaries that enter it from the east. The principal one branches off, under the name of the Blue Nile, from Khartoum. The other, the White Nile, comes in from the south. Judging by the reports of the stream, Bruce was induced to believe that the Blue was the principal source. He followed the Blue Nile, therefore, and thought he had visited the real source of the river. But there is also a source of the White Nile, and it is since known that the White Nile is the important feeder. Bruce followed the Blue Nile, and reached Cairo.

About three years afterwards a traveller named Browne endeavoured to reach the source of the White Nile by that course marked II. on the map. He made the first traverse across the Libyan Desert. He found the country for the most part arid, but containing a number of districts to a certain extent cultivatable. He went about 1000 miles with considerable difficulty, and was then obliged to return.

Very soon afterwards other attempts were made, but little of importance has been done successfully in this direction, except some attempts by the Pasha of Egypt when Mahommed Ali was alive. On this occasion the White Nile was ascended within a short distance of the Equator. At that point the expedition was obliged to return. The river when last seen in ascending was still 1000 feet wide, and the natives stated that it had its source thirty days journey further in the interior. This is the latest news, and the White Nile has not been traced beyond. When I come to speak of Captains Burton and Speke's expedition, it will be seen that one of them went northwards to very near this point, and found there a great lake.

The expedition marked III. was made by Hornemann in 1799, in the Sahara, in the direction of its length. Hornemann having reached Mourzouk, where the caravans for Tripoli called, endeavoured to get on to the great city of Timbuctoo, which is of importance as a place of trade in the interior of Africa. In endeavouring to do that he unfortunately died.

Afterwards a number of explorations were made, some from Tripoli, some from the west coast, all having for object to reach Lake Tsad, which was known as an important point in the interior, and to reach also the city of Tim-

buctoo. They reached the lake, and some of them reached the city also. It is not possible within the time allotted to this Lecture to do more than mention the names of some of the travellers who have visited this part of Africa. Among them was poor Mungo Park, Denham, and Clapperton, Major Laing and others, who all died, Caillié, a Frenchman, succeeded, by travelling as a Mohammedan, in crossing by Senegal through Timbuctoo to Tangier. Many expeditions have been started in this direction, and men were not wanting to risk their lives to obtain discoveries. The last expedition was the most important of all, and is known by Dr. Barth's account published in five thick octavo volumes. Barth started with Mr. Richardson and Dr. Overweg, a German. Both then died, and Dr. Barth remained alive, and came back again after a few years to describe the country he had passed over. He completely traversed that portion of Africa. I need only say now with regard to it that he reached Lake Tsad, marked in the upper part of the map, by a new route across the deserts. Afterwards he travelled southwards for some distance, and made several important trips. In the country thus visited, every part from near the Equator to 100 or 200 or 300 miles north of Lake Tsad was richly cultivated, thickly peopled, and although unhealthy, not so unhealthy as the part near the ocean. In fact, were it not for the difficulty thrown in the way of travellers by the natives, there would be no practical obstacles. Before Dr. Barth's return there was a great deal of uncertainty and anxiety as to his movements, and Dr. Vogel was sent out to meet him. The two travellers met, but Dr. Vogel soon after died.

The next expedition was conducted by Dr. Livingstone, who, in 1840, started from the Cape of Good Hope northwards, across the eastern edge of what was regarded as the Great Desert of South Africa. He found this desert more manageable than the Sahara. It was, indeed, only a dry country in the dry season, but in the wet season it was covered with vegetation, and with a large amount of animal life, including deer, and antelopes, and buffalo, rhinoceros, hippopotamus and elephant, with numerous lions and other large beasts of prey. These probably migrate during the dry season. After traversing the eastern borders of this land Dr. Livingstone reached the Lake Ngami, a small but interesting lake in the interior, and returned to the Cape. He returned northwards some time afterwards, and after passing the lake came upon the rivers which are the principal tributaries of the Zambesi. He followed the main stream northwards and westwards, through its principal tributaries, to their source near Loando, within about ten degrees of the Equator. He traced them to a small lake in an elevated marshy tract, forming a kind of watershed, inasmuch as from it the waters ran on one side to the Atlantic, and on the other to the Indian Ocean. The existence of the watershed in this position was unexpected and interesting. We are all so much in the habit of regarding the parting of waters as occurring on a ridge in a mountain country, that it is difficult to realise the idea of the drainage of a great continent diverging from a mere marshy plain, as it appears to do here.

Passing to Loando, the country near the watershed, which was a table-land tolerably elevated, was found to sink towards the coast. On the other side, towards the interior, the descent was hardly perceptible. The country which was travelled over was found to be well watered, and to be covered with a network of streams, every now and then expanding into open basins, and this, as far as he could learn, was the condition of the whole of the interior of the country between the western coast range and the eastern.

In this respect the form of the country corresponds with the interior of Africa generally. The principal point with regard to Dr. Livingstone's expedition, was the discovery that there was an elevated tract parallel to the coast all the way northwards, from the Cape to Loando, but nowhere a mountain range properly so-called. From the interior the country rose very gradually and very slowly, until the highest elevation of the plateau was reached. There was a considerable width of this table-land, but the width varied.

A section was then referred to which represented the country from the east side near the Indian Ocean to the west side at the Atlantic, and the position of the rim of the basin was shown to be in some places near and at others removed from the coast, being generally nearer on the west than the east side. The whole of the rest of the interior was rather depressed. Crossing the country completely, Dr. Livingstone saw distinctly all its principal features. There was an elevation on the west coast, a very gradual one, to an elevation of about 4000 feet, then a depression to about 2500 feet at Lake Ngami, but the depression was very gradual. On the other, or eastern side, the table-land was broken, and the river empties itself into the Indian Ocean.

The last of the important points determined with regard to the interior of Africa was by Burton and Speke, and is represented in the map exhibited, for which, as well as for the map of Dr. Livingstone's travels, I am indebted to the Geographical Society. Captain Burton proceeded from Zanzibar westwards, and went across a considerable tract of country, and after crossing the low coast lands, he came to a plateau, and there he found a great lake called Tanganyika. This lake has been mentioned by former travellers, but Captain Burton was the first who described it. It is 300 miles long, and 40 miles broad. Proceeding from that Captain Speke went northwards and eastwards to another lake, called Nyanza, about 4000 feet above the sea, a much higher elevation than the other, and nearer the coast. The lowest or southernmost part of this lake was only four or five degrees south of the Equator, and as described to him it was 300 miles long. He therefore almost connected it with the point which had been determined by the Egyptian expedition, and so with the White Nile. This conclusion is, however, hypothetical, and it still remains to go again to Nyanza, and to follow that lake to its northern extremity, and thence to proceed down to the White Nile itself, which in all probability proceeds from it. The discovery of a lake in that elevated district makes it extremely likely that the problem of the sources of the Nile is solved.

Australia is a country like Africa in some respects, but with a larger coast line in proportion to its area. With the exception of one great river, the Murray, it is a country apparently without important natural drainage, The other rivers, in fact, are small compared with this. The Victoria, entering the country from the north, reaches only the sandy desert, and most of the other streams do not even penetrate the coast range. The Murchison River on the west enters the interior and is of some interest.

What has been done hitherto in the way of Australian exploration amounts to little more than making out the country in the neighbourhood of the Great River. Between that Great River and the east coast there is an important range of high lands; they are called the Australian Alps in the southern part and the Blue Mountains in the north. Near these and in the river valleys are the gold deposits, so that the whole of that district down here is pretty well cleared up. From about Adelaide and that neighbourhood to Spencer Gulf, there have been several expeditions at different times towards the interior. Mr. Eyre was one of the early explorers; a good many years since he succeeded in going towards the north-west some hundreds of miles into the interior, but there he was stopped by a salt and apparently barren desert. He then returned, and endeavoured on the western side to get up by all possible means into the interior. The difficulty of reaching any distance into the interior all along that coast has been so great that it has never yet been overcome by any one. Not very long afterwards a great expedition was conducted by Captain Sturt northwards. He passed a great body of water, Lake Torrens, which, however, has no definite banks, sometimes drying up very rapidly in the dry hot weather, and frequently altering its outlines so completely that no mapped representation has any value. Beyond this the country has been explored

some hundreds of miles into the interior, but always terminates in the same desert, where the land is without water at the surface, although under ground there exist puddles which can often be found by the natives without great difficulty. The different expeditions reached so far that great danger was experienced, many of the party and the animals dying of drought. The work of discovery has been attempted, not only from the south, but also from the east. Dr. Leichhardt many years ago attempting to cross the country, and being so completely lost sight of for some years that it was supposed he had been killed, but he ultimately re-appeared, and then attempted to penetrate southwards, and was altogether lost sight of.

On the north there was an expedition conducted by Mr. Gregory, which was successful, inasmuch as he succeeded in crossing the coast range, but he also then came to very much the same sort of desert as is found on the south. There seems, therefore, all round Australia, a considerable tract of coast range near the sea, beyond which, in the interior, nothing has been discovered.

The general result of investigation can be briefly described:—

On the south-east coast, first peopled, the land soon gives place to a continuous chain of mountains called the Blue Mountains, behind Sydney, the Australian Alps to the south.

Within these mountains is a large and very important tract now coming into cultivation, watered by the numerous feeders of the Murray River. Of these the Darwen, Murrumbidgee, and Lachlin, are the best known. There is a belt of high ground all round the east coast, and, indeed, almost round the whole continent, but no lofty mountains have been detected except the chain already alluded to. It is now considered as proved that the whole N.-W. of Australia consists of table-land rising a little to about 300 miles from the coast, and averaging 1600 to 2000 feet above the sea, and extending to 300 miles in the interior. Beyond that the ground seems to fall very gently, very much in the way it does in Africa.

Now let us endeavour to connect these various threads and shew their meaning, and the great physical truths to which they point. Africa possesses an east and west mountain chain, forming the north shore of the Mediterranean from Tangier to Tunis, and belonging almost more to Europe than to Africa proper. If this chain were absent, or rather if it were connected with Sicily and Italy, the Sahara in its northern portions would greatly resemble parts of the west coast of Africa between the sea and the coast range. Within this, at a distance of about 150 miles, appears to be really another coast range, part of a great belt of high land, varying from 1000 to 6000 feet, forming a broad plateau some two or three hundred miles wide, all round Africa, broken only where the Senegal, the Niger, the Orange River, the Zambesi, and the Nile, communicate with the interior. Numerous small streams come from this side of the coast range of table-land towards the sea, to the Atlantic on one side and the Indian Ocean on the other. But the great extent of Africa is within this belt, certainly five millions out of the eight millions of square miles of its area.

Within this space the ground gradually falls towards the centre; there are probably no mountains of any importance, but in their place a network of rivers, here and there forming great expanses of shallow water.

A large part of this tract is not only cultivable, but rich and covered with vegetation. It is thickly peopled, not only by wild animals, but by human beings in a state of imperfect civilisation—by no means in a state of utter barbarism. They travel, they communicate with each other, and with Arabia, the country of whose people they know most. Mohammedanism has spread imperfectly amongst them.

The rain that falls within this large area, conveyed by winds that have previously crossed the Indian Ocean or the Atlantic, is certainly not inconsiderable, but it falls periodically. During the intervals there would be much drought if it were not for the network of rivers and the lakes. But, in consequence of these, the air is kept moist, and vegetation, if where the soil is thin it dries up in summer, is soon recalled to vigorous existence when rain time comes. It is however one consequence of this, that in their present state the rivers are few of them navigable all the year, and serve badly as means of communication for trading purposes.

In a country where there is so much evaporation, we need not be surprised if salt, carbonate of soda, and other minerals resulting from the evaporation of sea water, are occasionally found. They are not however very extensive, and the lakes are fresh when the rains have fallen. In all this description one thing is remarkable—Africa has no central mountain chain; its drainage is not all outwards, but for the most part towards the interior; its watersheds are plains, not ridges.

Australia is not altogether like Africa, but is not altogether unlike it; it resembles it in many important points. It has for the most part a narrow, often an exceedingly narrow, line of rich lands on the coast, intersected at seasonable intervals by very small streams. It has no doubt one large river, or rather system of rivers connected with mountain systems, but this is confined to the south-eastern part of the country; within the outer line is a vast space, perhaps a million of square miles, of hitherto untrodden ground, a great part of it so barren and inhospitable that it seems hardly capable of occupation. Water falls there, but is soon lost, the river courses being usually quite dry, though here and there there are puddles and holes which indeed are sometimes beneath the surface. Within this tract, part of which is covered with salt, there may no doubt be oases, cultivable spots, but they are not yet reached.

This structure also is apparently quite exceptional. We have placed before us a sea bottom, dried up by evaporation, where there were not sufficient means to draw off the water during elevation. The causes of this can only have been that the whole area has undergone elevation round its outer edge instead of being lifted on a mere line, whether straight or curved. In this respect Africa and Australia agree. They shew a form resembling that of a sea bottom, such as the Pacific appears to be—a basin of an oval form with elevated sides—not such a trough as the Atlantic, enclosed only on two sides with high ground.

The structure of the two tracts of continental land whose configuration I have in this lecture endeavoured to explain, seems therefore to shew a decided contrast to that of the other great lands of the earth. Europe and Asia have one long axis, the Himalayan Chain sinking westwards into the Carpathians and Alps, and dying away in the western Pyrenees and the Atlas Chain. The two Americas have a corresponding north and south axis running through both from pole to pole. In the one case in Asia and Europe, the great mass of the land elevated consists of plateaux, plains, and valleys, on both sides the mountains, traversed by great rivers, originating on opposite sides of the chain, and diverging. In the other case the land is all on one side of the mountains, and the drainage crosses it. In Africa and Australia the mountains are for the most part of inconsiderable height, but they form a barrier round a central area, which is little better than a gigantic puddle, receiving the rain when it falls and collecting it into pools, but not producing any system of navigable rivers except in the comparatively few cases where the outer enclosing barrier is broken through. Fortunately for Australia, the south eastern part of the country is more like the condition of parts of Europe than that of the remainder, but Africa must ever remain difficult of access and more unhealthy than necessarily belongs to the latitude in which it is placed. I would say, as a concluding remark, that the low state of the indigenous tribes in Africa and Australia fully illustrates the unfavourable conditions for human existence that prevail in those countries.

The next Lecture by Professor Ansted, *On Earthquakes*, will appear immediately.

NOTICES OF BOOKS, PATENTS, &c.

The Retrospect of Medicine: being a Half-yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, *Lecturer on Obstetric Medicine at the Leeds School of Medicine, &c.* vol. xli. *January to June* 1860. London: Simpkin, Marshall & Co.

Mr. Braithwaite's volume appears punctually as usual and contains the usual amount of well selected matter.

As we remarked on a former occasion, the work does not contain much of immediate interest to chemists and druggists. The study of pharmacy has been entirely abandoned by medical men, and even that of therapeutics in the present day is in no great favour. It is not surprising therefore to find but little relating to medicines in the present volume, and that little not of a kind which is likely to be very useful to our readers. We find a few things, however, which will be novelties to some, so we shall make a few extracts; and first how

"*To make a Blister.*

Take of Cantharidin 1 dram
„ White wax 1 dram
„ Olive oil 5 drams]

melted together, mix. With a brush paint it over some white bibulous paper, and hang it up to dry in a current of air. Take a piece of pink paper form and size required, and paint the under coloured side over with a weak solution of india-rubber; cut your cantharadin paper the form and size (less a margin) of the pink paper, — while the india-rubber solution is still sticky place it on, when dry roll it up. It is unaffected by damp, is light, portable, blisters with certainty and without pain (?) The introduction of the caoutchouc varnish arrests the perspiration of the part, and increases doubly the certainty, while diminishing the time required for application. Before applying, the blister should be held over the steam of hot water. The same blister will be effectual several times."

We find also an improvement in fused nitrate of silver, suggested by an American pharmaceutist, which if it answer the purpose stated will be decidedly advantageous in surgical practice. The brittleness of the ordinary lunar caustic stick has been the cause of serious mischief, and every one has found the difficulty of scraping it to a point.

"This new form of lunar caustic is prepared by adding a definite proportion of hydrochloric acid to the crystals of nitrate of silver at the time of fusing, and pouring the fused mixture into moulds in the usual way. The proportion of the officinal acid which gives five per cent. of chloride in the fused nitrate, is forty grains to two ounces of the crystals.

"The sticks of lunar caustic thus made are of a darker colour than usual, in consequence of the more rapid effect of light upon the chloride. They are harder, much less soluble, and of about double the strength or toughness of the pure nitrate. When fused nitrate of silver is perfectly pure, the sticks are greyish white, translucent, of a crystalline structure, and are very brittle, almost friable, and so soluble that, in application to moist surfaces, more of the salt is left upon the tissue than is desirable.

"The increased strength of the sticks in this new form, and the diminished solubility, must therefore prove to be very valuable qualities in a large proportion of cases where the nitrate is used, while as yet there are no known disadvantages from the admixture."

We have too the following very simple method for detecting adulterations in nitrate of silver:—

"A small fragment of nitrate of silver, say four times the size of a pin's head, crushed to powder with a knife-blade upon a piece of paper, the powder spread out over the paper, and the paper and powder then rolled up into a small match-like roll, set on fire, and burned, leaves a tasteless residue of pure silver. But if the nitrate contains even 1 per cent. of any saline impurity, the residue, instead of being tasteless, will have the sharp alkaline taste of the base of the adulterating salt. The little match burns rapidly with deflagration, and provided the quantity of the nitrate taken be not too great for the size of the paper, and provided the powder be well distributed through the paper, the carbon of the paper will, in burning, reduce perfectly all the silver, and in great measure the base of the adulterating salt also.

"With this simple test no one need be deceived in the character of the lunar caustic he uses, until some new and more fixed adulterating substances are found. The chloride of silver in the new form does not interfere at all with the application of this test, since in that case also the residue is tasteless."

From an able *resumé* by Professor Davy of the progress which toxicology has made within the last few years, we quote the following notice of a new antidote for strychnia.

"One of the most remarkable substances as yet proposed as an antidote for strychnine is nicotine, the active principle of tobacco, which was suggested by the Rev. Samuel Haughton, F.T.C.D. a gentleman who diffuses some new light on almost every subject he investigates. Mr. Haughton was led to try the effects of nicotine as an antidote from the opposite physiological properties of that substance when compared with those of strychnine (the former producing relaxation, and the latter contraction of the muscles), and he conceived that it was possible, from their opposite effects, that they might mutually neutralise, as it were, each other's action. To determine this important question he instituted several interesting experiments on frogs, which he placed in different solutions of strychnine and of nicotine, and the results clearly show the correctness of his inference as to nicotine being more or less an antidote to strychnine."

An infusion of tobacco, it appears, has been used with success in the United States. From another paper we learn that tincture of iodine was used in one case of poisoning by strychnia, and with apparent success, for the patient recovered. How far the tincture of iodine contributed to the cure it might be hard to say, but the result is worth knowing, and information of this kind cannot be too widely diffused.

Medical men must find the *Retrospect* a very useful compilation.

CORRESPONDENCE.

Action of Coal Gas on Iron Pipes.

To the Editor of the Chemical News.

Sir,—I have just seen in the Chemical News of the 14th inst. two reports, one by Mr. T. Spencer the other by Dr. Letheby, referring to the effect of the action of coal gas on cast iron pipes.

I have somewhere met with a theory on the properties of iron, something to the following effect:—That iron and carbon do not combine chemically together of themselves. That good workable merchant bar iron contains as much carbon as pig or cast iron generally does.

Chemical analysis gives the constituents of these two nearly similar while the properties of the two states of iron differ widely. The theory to which I refer supposes that in the bar iron the carbon is combined through the medium of oxygen, while in the cast iron it is combined through the medium of nitrogen; or, in other words, that bar iron is alloyed with what is technically termed cinder, while cast iron is alloyed with cyanuret of iron.

Now, if for a moment we suppose this theory to be correct, it would satisfactorily account for the effects of the action of coal gas upon cast iron pipes.

The hydrogen attracting the nitrogen from the cyanuret to form ammonia a partial decomposition of the iron would at the same time be going slowly on.

I remember to have read in the *Times* some three or four years age, some remarks on the presence of ammonia in gas,

which, if my memory serves me rightly, were by Dr. Letheby, wherein a circumstance is stated that gas which was proved to be free from ammonia when it left the gas-works was found to contain ammonia when conveyed into the premises of the consumer.

Ammonia must thus have been formed in the pipes. These circumstances appear to me to favour the above theory; I have therefore thrown these remarks hastily together to draw to the subject, which is really an interesting and important one, the attention and research of more expert metallurgists than I profess myself to be.—I am, &c.

C. J. S.

Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—From the following axioms of physics I have based the following proposition:—

Axiom 1.—That which is neither infinite nor infinitesimal is definite.

Axiom 2.—That which is elastic cannot be perfectly hard.

Axiom 3.—An atom is indivisible matter.

Axiom 4.—That which is perfectly hard cannot be subdivided.

Axiom 5.—There are two kinds of matter—solid and fluid.

Axiom 6.—Elasticity depends upon the amount of motion among the small constituent particles of matter.

Axiom 7—The compound resulting from the mechanical union of solids cannot be fluid, but must likewise be solid.

Axiom 8.—No fluid is perfectly inelastic.

Proposition.—Matter is infinitely divisible.

Demonstration.—If matter be not infinitely divisible, there will somewhere be a stop to its subdivision (ax. 1). The ultimate atoms of matter thus arrived at will be indivisible (ax. 3).

Because atoms are indivisible, therefore they are perfectly hard (ax. 4).

Because no fluid is perfectly inelastic (ax. 8), therefore, no fluid can be perfectly hard (ax. 2). Because atoms are perfectly hard, therefore they cannot be fluid. But that which is not fluid must be solid (ax. 5), therefore atoms are solid. Because atoms are solid no number of them can form a fluid (ax. 7), therefore fluids are not matter (ax. 3), which is absurd (ax. 5). *Therefore matter is infinitely divisible.*—I am, &c.

T. S. Barrett.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Permanganate of Potash.—The asserted non-existence of permanganic acid induced Machuca[1] to analyse permanganate of potash. The results obtained confirm those of Mitscherlich and are decisive as to the existence of the acid in question. The author analysed the permanganate in two ways: he first estimated the manganese and potassium by the known methods, and, secondly, he determined the amount of chlorine set free by the action of hydrochloric acid on the permanganate. The salt was well dried either in a stove or under the air pump The numbers obtained in four experiments were as follows:—

	1.	2.	3.	4.	Theory.	
Mn	34·63	34·59	34·52	34·60	2Mn	34·82
K	24·37	24·45	„	„	K	24·68
O	„	„	„	„	8O	40·50
						100·00

If the formula Mn_2KO_8 be right 100 parts of the permanganate of potash ought in decomposing hydrochloric acid to set free 112·3 parts of chlorine. The author estimated the chlorine by the methods of Gay-Lussac, one of which is based on the transformation of arsenious into arsenic acid and the other on the change of sulphurous into sulphuric acid, the latter being weighed in the form of sulphate of baryta. In one experiment Machuca found that Mn_2KO_8 disengaged 112·0 parts of Cl and in a second 112·18.

Colouring Matter of Rocks, &c.—M. Fournet continues[2] his communications on what he calls the *organico-mineral* colouring principles. He has examined a tertiary clay from Algeria and finds that it contains some colouring matter soluble in acids, in water, in alcohol, and in turpentine, which plays the part of a base with an acid, and that of an electro-negative element with an alkali, with which it combines to form compounds but slightly soluble. By means of various reagents he procures with it a number of colours which partly depend, he says, on the manner in which the matter is separated from the gangue. The author believes this colouring matter (about the composition of which however he has told us nothing as yet) to be very like the green and red principle found in the mineral waters of Vichy. He has also found the same substance in some Algerine jasper, which he regards as the clay agglutinated and consolidated by means of a strongly siliceous fluid.

New Salts of the Suboxide of Silver.—Wöhler[3] forms *molybdate of the suboxide of silver*, $Ag_2O.2MoO_3$, by passing a current of hydrogen through an ammoniacal solution of molybdate of silver. The reduction takes place at the ordinary temperature even when operating on the dry salt, but it is effected much more rapidly when the solution is heated to about 90°. It forms a heavy brilliant black powder in which small, well-formed, regular, octahedral crystals may be recognised. Nitric acid dissolves it and disengages protoxide of nitrogen. Potash removes the molybdic acid and leaves a black residue of the suboxide of silver.

The *tungstate* of the suboxide $Ag_2O.2WO_3$ may be formed in the same way as the molybdate. It also forms a brilliant black crystalline powder which under the microscope shows rhombic facets. Nitric acid decomposes this salt, dissolving the silver and leaving a residue of tungstic acid. Potash on the contrary takes the acid and leaves the base.

The *chromate* is produced under the same circumstances, but always contains some metallic silver, and is completely reduced below 50°. It is an amorphous, black powder which dissolves in strong nitric acid giving a red colour, and in dilute giving a green, the suboxide of silver in the latter case reducing the chromic acid to sesquioxide of chromium.

The arseniate of silver dissolved in ammonia is coloured brown by hydrogen and after a long time deposits a small quantity of black powder.

The arseniate and yellow phosphate of silver are instantaneously changed by a solution of sulphate of protoxide of iron into a grey-black powder which, according to Traun, is a mixture of suboxide and metallic silver. Oxalate of silver is immediately reduced by the same agent to the metallic state. The chloride is not affected.

Geuther has noticed that cuprous hydrate is blackened on the addition of nitrate of silver, no doubt in consequence of the production of suboxide of silver. When a very little cuprous hydrate is added to a dilute solution of silver and the mixture is heated the cuprous hydrate dissolves, and after some time the reduced silver is deposited in brilliant crystalline lamellæ. According to the same chemist chloride of silver is reduced to the metallic state when boiled with a slightly alkaline solution of sulphite of soda to which a little sal ammoniac has been added.

II. ORGANIC CHEMISTRY.

The rational Formula of Fulminic Acid.—Two different formulas have been proposed for fulminic acid. One proposed by Chickhoff,

$$C_2NO_2H_2N.2CHNO$$

represents it as a compound of mononitrated acetonitrile

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[1] *Comptes-Rendus*, t. li. p. 140.

[2] *Ibid.* pp. 79—112.

[3] *Annal. der Chem. und Pharm.* Bd. cxiv. s. 119.

with two equivalents of cyanic acid. The other, proposed by Kékulé,

$$\mathrm{CN.CH_2(NO_2)}$$

regards it as a cyanide of mononitrated methyl. Afterwards Kékulé obtained the compound $\mathrm{CN.CBr_2(NO_2)}$ by the action of bromine on fulminate of mercury. The simplicity of Kékulé's formula, and the discovery of the bromine derivative, decided most chemists in favour of this formula.

In some new researches Chickhoff[4], among other results, has proved by a comparative study of the properties of the fulminates with those of the isocyanurates, that fulminic acid in dividing into isocyanuric and cyanic acids undergoes a decided molecular change. The composition of the two isomers (fulminic and isocyanuric acids) must therefore be represented by different formulas.

The following most easily explain the properties of these acids.

$$\mathrm{C_2(NO_2)_2H_4(CN)_2}\ \text{fulminic acid}$$

$$\left.\begin{matrix}\mathrm{C_2(NO_2)H_2O}\\ \mathrm{CN}\\ \mathrm{H}\end{matrix}\right\}\mathrm{N}\quad\text{isocyanuric acid.}$$

The first represents a derivative of ethylic alcohol by the substitution of cyanogen for oxygen and two equivalents of the group $\mathrm{NO_2}$ for two of hydrogen. The second for isocyanuric acid represents *nitro-acetic cyanamide*. The new formula for fulminic acid easily explains not only the manner in which that body is formed by the action of nitric acid on alcohol, but all the general properties of the fulminates as well.

It is known that in the action of nitric acid on alcohol there is always found a considerable quantity of hydrocyanic acid: at the same time there is produced *binitrated ethylene* $\mathrm{C_2(NO_2)_2H_2}$; and these two combine to form fulminic acid. Thus:

$$\mathrm{C_2(NO_2)_2H_2 + 2CNH = C_2(NO_2)_2H_4(CN)_2}$$

The following facts show that this formula easily accounts for the different reactions of fulminic acid.

1. The fulminates possess the essential properties of the cyanides: they are very poisonous: by the action of bromine and chlorine, bromide and chloride of cyanogen are disengaged: treated with hydrochloric acid, hydrocyanic acid is given off. In all these reactions the fulminates behave exactly like the cyanides.

2. Whenever the silver or mercury, &c. of the fulminate is replaced by an alkaline metal, the cyanate of the base employed is formed.

3. The explosive properties of the fulminates are explained by the instability of the binitrated ethylene, and the readiness with which the oxygen of this body is carried to metallic cyanides. We may remember that mixtures of the metallic cyanides with bodies rich in oxygen are highly explosive.

4. The existence of the body $\mathrm{C_2(NO_2)_2H_2}$ is at present hypothetical, but after the discovery of the compounds $\mathrm{C(NO_2)_3H}$, and $\mathrm{C_2(NO_2)_3N}$, &c. the formation of such a body does not appear improbable.

5. When it is attempted to displace the metal of the fulminates by double decomposition, the displacement of but half is usually effected. The explanation of this fact is also found on the supposition that the fulminates are double salts of two different acids, the binitrated ethylene and hydrocyanic acid.

The author concludes by explaining his belief that when the new compound is obtained it will be possible to effect the synthesis of the fulminates, by treating the new body with the oxide of a metal, and then combining it with two equivalents of a metallic cyanide.

Artificial Racemic Acid.—M. Carlet[5] remembering that *dulcine* had no action on polarised light, thought it would be interesting to see what might be the optical properties of the tartaric acid which could perhaps be formed from it. He accordingly treated dulcine by Liebeg's process for sugar of milk (with some small modifications which he intends to particularise hereafter) and did in fact obtain a very minute quantity of cream of tartar. From this he separated the acid and crystallised it, and found it to be paratartaric or racemic acid. The crystalline form, chemical properties, and composition of the natural and artificial acid all coincide, but the most important fact to prove the perfect identity is the splitting up of the artificial acid into the right- and left-turning forms of tartaric acid. Thus, says the author, we obtain from an inactive body another body equally inactive, but capable of being divided into two bodies each possessing an equal rotatory power in an opposite direction; and from this he infers the probability that dulcine is only apparently inactive, and that it is composed of two matters endowed with molecular rotatory powers, whose actions on polarised light neutralise one another. It remains to demonstrate this, and to that end the author is now exerting himself.

Two active Principles in the Squill.—M. Mandet[6] has separated two active principles from the *scilla maritima*—one an irritating poisonous body to which he has given the name *skuleine*; the other, *scillitine*, possessing in a high degree all the diuretic and expectorant properties of the squill, but incapable of producing the accidents which have followed the administration of some of its preparations. We hope we shall soon be told how the latter useful and harmless body is separated from its dangerous relative.

III. CHEMICAL ANALYSIS.

Detection of Ergot in Rye Flour.—Pure and white rye flour keeps its colour when mixed with water in a mortar: but Elsner points out[7] that if only two per cent. of ergot be added, the flour when wetted changes from white to a chamois leather colour. With but one per cent. the change is apparent. Wittstein gives a process[8] founded on the disengagement of trimethylamine when ergot is treated with potash. The suspected flour is moistened with water, and then introduced into a tube and covered with a solution of caustic potash. In a short time the fishy smell is very apparent, but it is developed much more quickly when the mixture is heated. It is best, the author thinks, to operate in the cold, and cork the mixture up in the tube. The flour then becomes yellow, and at the same time manifests the odour in question.

Adulteration of Wheaten Flour and Starch with Potato Starch.—A chemist unprovided with a microscope will be glad to have a good process for detecting the above adulteration. Puscher gives the following[9], founded on the peculiar smell which is given off when potato starch is treated with a cold mixture of 1 part sulphuric acid and 2 parts of water. The fecula swells up, becomes transparent, and emits the odour of fusel oil, which latter, neither wheaten flour nor starch does, although they swell up like the potato fecula. According to the author the process will detect one per cent. of the last in a mixture.

IV. TECHNICAL CHEMISTRY.

New application of Glycerine.—Dry gas meters will soon, we suppose, entirely supersede the use of wet ones, so that the suggestion of M. Fabian, to employ a mixture of glycerine and water in the latter, in order to avoid the inconvenience of having the meter frozen in the winter comes too late for us. Fabian shows[10] that a mixture of glycerine and water, of the density 1·120, is never likely to be frozen by any degree of cold to which the meter can be subjected in this country. He says too that the thickness of the glycerine does not interfere with the progress of the mechanism.

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[4] *Comptes-Rendus*, t. li. 99.
[5] *Ibid.* 137.
[6] *Ibid.* 88.
[7] *Journ. de Pharm. et de Chimie*, t. xxxvii. p. 476.
[8] *Chemisch. Centralblatt.* No. 93.
[9] *Polytech. Journ.* Bd. clv. s. 391.
[10] *Ibid.* 365.

LABORATORY MEMORANDA.

Microscopic appearance of Ginger Root.—Sir,—In reference to the Adulteration of Food and Drink Bill I beg to notice a peculiarity in the microscopic appearance of ginger root.

When a slice of *soft* ginger root is experimented on, the starch granules are of a long lozenge form and tolerably regular as to size, and if touched with a drop of a solution of iodine, as is generally known, they present the usual appearance of blue iodide of starch, but it is otherwise with a piece of *hard* or dark-coloured Jamaica ginger, as then not only are the starch granules of a different shape, but when touched with iodine they assume a sepia colour and are peculiarly marked and transparent, having six or seven bands not unlike in form and character the shells of some varieties of snails. It is obvious, therefore, that if two pieces of ginger, one soft and the other hard be ground up together (although *both are genuine*), they will, under the microscope, present a different appearance, as if adulterated, but with what, for this note, it would be difficult to say.—I am, &c.

JOHN HORSLEY, F.C.S.
Chemical and Microscopical Analyst.

The Laboratory, 389 High St. Cheltenham.

MISCELLANEOUS.

The Liverpool Poison Cases.—The prisoner Winslow has been committed for trial. We have not yet received the chemical evidence, of which we intend to give a full report.

Arsenic in the River.—Apropos of Dr. Letheby's Report on the presence of Arsenic in Dale's Perchloride of Iron, Mr. R. C. Clapham writes to the *Engineer*, to say that, "at moderate calculation, about 4 cwt. of arsenic in the form of chloride is run into the Tyne daily, and probably twice as much into the Mersey, and that up to this time no injurious effects are known to have followed." The conditions of the Tyne at Newcastle, the Mersey at Liverpool, and the Thames at London are very different, and we don't see why the Thames should be poisoned because the Tyne and Mersey are.

Science and Art Department.—The following students at the Secular School, Glasgow, gained the chemical prizes at the examination lately held by Captain Donelly, R.E., Science Inspector.

Alexander Esilman and Joseph Crawford Withers—1st class Queen's prizes.

William M'Ilwraith, James Adam, and John Stevenson—2nd class Queen's prizes.

Alexander Adamson—3rd class Queen's prize.

Besides the above, the following pupils passed satisfactorily:—

Edmund Wilson, Henry Hederwick, and Joseph Bonner.

American Salt.—If the sea were the only source for furnishing salt, the interior of America would perhaps be rendered uninhabitable. It has been far otherwise ordered, however, as there are found vast reservoirs of salt in the condition of saturated brine extending over an extensive area in several States. These saline subterranean fountains are indications of a pre-arrangement for the supply of this useful agent to a vast population, just as the great coal fields afford indications of a pre-arranged supply of fuel for the development and advancement of civilisation. In the centre of New York the salt springs of Salina are a source of state revenue, and they are essentially more useful than gold mines. In Pennsylvania and Virginia there are also very many brine springs which afford salt for the people, and recently a very valuable one has been opened at East Saginaw, Michigan. The bore of this spring is only 3⅛ of an inch in diameter, but the supply is very abundant, as by continual pumping for 36 hours, drawing 22 gallons per minute, there was no sensible diminution noticed. The well is 617 feet deep, and a pint of the brine (by the analysis of Prof. J. G. Webb) contains 1416 grains of pure chloride of sodium and 32 grains of solid impurities. A bushel of commercial salt has been obtained from 23½ gallons of the brine. The East Saginaw Salt Company are about boring another spring of 6 inches in diameter, and, no doubt, they will soon be able to supply a large quantity of this necessary article. In 1858, the New York salt springs yielded 7,033,000 bushels, most of which was sent to the North and West; no less than 1,669,000 bushels of it having been entered at the single part of Chicago. The discovery of salt springs in Michigan, therefore, is held to be of vast importance to the north-western States.

Wax and Rosin for Painting.—To oil coats there is this objection, that they require a comparatively long time to dry. When oil of turpentine is used, though it evaporates fast enough, it leaves the painting soft; and although, by the addition of some other substances, the drying may be hastened, it even then takes up to much time, and leads to the substitution of whitewash and other water colours. Mr. Alluys now proposes a mixture which yields a coat of paint that will dry as fast as whitewash, but leave as durable and elastic a coat as that of oil. To prepare it, instead of more linseed oil, as usually, he adds to the paint, ground in oil, a solution of wax and rosin in spirits of turpentine. The mixture thus prepared has the appearance of common oil paint, and acts like such. On the evaporation of turpentine, it leaves a coat sufficiently hard to bear gentle rubbing without coming off. Barreswil has reported some experiments with this mixture, and finds that, although it becomes sufficiently dry and hard after a time, it does not equal a good oil coating in this respect; but he has no doubt that for some purposes it will be found quite desirable. He gives the following formula for its preparation: 10 parts of pure yellow wax are dissolved in the same quantity of linseed oil, and 5 parts of rosin in 8 of spirits of turpentine, at a slow heat (in separate vessels) until quite liquid; when they are taken from the fire and mixed, with constant stirring, until they thicken. In this condition the mixture serves for out-door and store-work. If to be applied with ground paints, it is thinned with spirits of turpentine as required.—*Dingler's Polytechnic Journal.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

G. G. "Spiritus Mindererus" is an old name for liquor ammonia acetatis.

J. F. is thanked. The subject is under consideration, and the wish of our correspondent will most likely be complied with.

R.—Weak acetic acid will probably answer.

C. T.—All the laboratories open in October.

M. M.—You will be subjected to an examination before the permission is granted.

P. J. (Brechin).—We can find no patent for any similar process.

Analyst.—The act says "with competent medical knowledge;" but it does not follow that the analyst must be a medical man. Every chemist has enough medical knowledge to know that arsenic, copper, lead, cocculus indicus, and such things are poisonous, while but few medical men are competent analysts.

Received—*Scrutator.*—*C. J. S.*—*J. M.*—*G. H.*—Answers next week.

Book received—*The Technologist*, No. 1. Edited by P. L. Simmonds, *F.S.S.*

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THE CHEMICAL NEWS.

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THE SALE OF POISONS.

THE sale of poisons is a matter the consideration of which we always approach with pain and reluctance. The extreme importance of the subject, and the apparent hopelessness of finding a solution of the practical difficulties in the way of legislative interference, invest it with no common interest, while too frequent occurrences continually thrust it on our attention. A fortnight ago we had to record the trial of a son for what was accepted as the accidental poisoning of his mother with prussic acid. The prisoner was indeed a medical man, but it seems doubtful whether he was a person who ought to have been trusted with so dangerous a medicine. But we may let that pass for the present. The attention of the House of Lords will be called to the case on Monday next, and a circumstance which seems to have been suppressed at the trial may perhaps receive further investigation. The fact of the purchaser being a medical man might be held in this case to justify the sale of an active poison; nevertheless, we should have been pleased to see more caution exercised, and a more exact knowledge exhibited, by the seller.

Our impression to-day, however, contains an account of two probable cases of poisoning by means of an article which ought never to have reached the hands of unprofessional persons, and we at once direct the attention of our readers to the matter, in the hope of preventing the repetition of a crime which threatens to become epidemic, as the arsenic poisonings were some years ago. Tartar-emetic is by far too active a medicine to be entrusted to any other than medical men. As a poison for vermin, it is one of the worst that could be chosen, for a large dose generally acts as its own antidote. It is never used in the arts, nor, within our knowledge, for any other than medicinal purposes. How comes it then that it is possible for such an individual as the accused at Liverpool to become possessed of so powerful a poison. The answer is but too clear. There must be persons engaged in the sale of medicines who, either from ignorance, thoughtlessness, or cupidity, are willing to sell any poison for which they may be asked. To some of these it may be useless to appeal, but we are satisfied that no respectable druggist who is conscious of his responsibility and careful of his reputation will ever sell tartar emetic on any pretence whatever to any other than a medical man.

We are no advocates for a law which shall either prohibit or place great restrictions on the sale of poisons. Such laws generally defeat their own object. So many of our most dangerous poisons are in such constant demand for harmless purposes that a restrictive act of Parliament would only make the sale of them secret instead of open, and thus would give greater confidence to an intending murderer. The legislature has more than once tried the experiment of prohibiting the sale of things in constant demand, and always with the same absence of success. In 1726 an attempt was made to suppress drunkenness by prohibiting the retail sale of spirits; but the law, by making the trade secret, only increased the evil it was intended to remedy. In 1820 it was thought to stop poaching by forbidding the sale of game under a heavy penalty; but the only consequence was that the sale of game passed into the hands of a different class of people. And so we are convinced it would be with poisons. Many of them are in constant demand, and therefore would be sold; and if not by respectable chemists and druggists, then by another class of persons who would exercise much less caution.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Notes[1], *by Dr.* J. H. GLADSTONE, *F.R.S.*

1. On the Diffusion of Salts in solution as bearing evidence of their Reciprocal Decomposition. —In my paper *On Circumstances modifying the Action of Chemical Affinity* there occurs the following remark[2]:

"Professor Graham has shown[3] that binary compounds vary greatly in the rates at which they diffuse through water. Let it be supposed that A B and C D are mixed in one of his diffusion cells, and that the compounds of A diffuse more rapidly than those of C. If no decomposition take place upon mixing, the amounts of A and B in the diffusate will be in equivalent proportions; and so will likewise the smaller amounts of C and D. If a complete interchange of acids and bases take place, the amount of A in the diffusate will exactly correspond atomically with that of D, and in a similar manner C with B. If, however, A and C divide themselves between B and D, as the four compounds will be unequally diffusive, it will be very improbable that the amount of either A or C in the diffusate should happen just to correspond with the amount of either B or D. There is nothing in Professor Graham's published researches that will indicate which of these is the case, nor have I made any experiments on the subject; but I entertain little doubt that the latter result would be arrived at were the matter to be investigated."

Since this was published the experiment has been tried. Chloride of sodium and nitrate of baryta were

[1] Read at the Chemical Section of the British Association.
[2] *Phil. Trans.* 1855, p. 217. [3] *Ibid.* 1850.

the two salts chosen. Now chloride of sodium is known to diffuse more rapidly than the nitrate of soda, or than chloride of barium; hence in all probability more rapidly than nitrate of baryta. But whether that be the case or not, it was extremely improbable that an equivalent of chloride of sodium should have the same power of diffusion as one of nitrate of baryta, seeing that "the relations in diffusion of different substances refer to equal weights of those substances, and not to their atomic weights or equivalents."[4] The two salts therefore were mixed together in equivalent proportions, and allowed to diffuse for some time. The relative quantities of the two acids and the two bases in the diffusate were then determined.

Now it was hypothetically possible that the two salts should not decompose one another, in which case we should obtain as the diffusate—

$$a(NaCl) + b(BaO,NO_5)$$

the amount of chlorine being exactly equivalent to that of sodium, and the amount of nitric acid to that of barium. Or the two salts might have decomposed each other perfectly, in which case the diffusate would have been—

$$c(NaO,NO_5) + d(BaCl)$$

the amount of nitric acid being equivalent to that of sodium, and the amount of chlorine to that of barium. But if the law of reciprocal decomposition hold good the diffusate would consist of—

$$e(NaCl) + f(NaO,NO_5) + g(BaCl) + h(BaO,NO_5)$$

in which it is extremely improbable that the amount of either the chlorine or the nitric acid should be equivalent to that of either the sodium or barium. And this is what actually took place; for the relative proportions of the four substances in the diffusate, when expressed in *equivalents*, were found to be as follows: —

Sodium .	. 1253	Chlorine .	. 1175
Barium .	. 812	Nitric acid .	. 892
	2065		2067

Thus the diffusate could not have consisted of chloride of sodium and nitrate of baryta only, nor yet of chloride of barium and nitrate of soda only, but it must have contained all four salts. In what relative proportion these were mixed (or the values of *e*, *f*, *g*, and *h* in the above formula) there is nothing in the data to determine.

There is certainly another alternative with which the above figures are in perfect consonance, namely, that the diffusate consisted of three salts, chloride of sodium, nitrate of baryta, and nitrate of soda, and indeed in the following proportions expressed in equivalents—

$$1175NaCl + 812BaO,NO_5 + 78 \text{ or } 80NaO,NO_5)$$

But if some sodium really entered into combination with nitric acid it must have left its chlorine, which would of course combine with the barium set free at the same time; and as there was nothing in the arrangement to keep back the chloride of barium it must have diffused more or less with the other three salts. In any case the fact of reciprocal decomposition is equally proved.

In a previous experiment nitrate of potash and chloride of calcium were the salts employed, and the proportions of the four components in the diffusate, expressed in *equivalents*, were—

Potassium .	. 554	Nitric acid .	. 416
Calcium .	. 462	Chlorine .	. 601
	1016		1017

[4] Graham, as above.

This result is very similar to that given above, but it is not equally conclusive, for unfortunately the two salts were mixed in unknown proportions, and hence there is no answer to the objection that the nitric acid may have entirely passed over to the lime, the potassium entering into combination with the freed chlorine, and a portion of chloride of calcium remaining over and above. At least it would require a knowledge of the relative diffusibility of nitrate of lime and chloride of potassium, which we do not at present possess.

The law of reciprocal decomposition among salts in solution will perhaps be considered sufficiently established not to need this confirmation, but it is pleasant to verify a prediction, and it is something to add to a cumulative proof by an experiment of a different kind to any of those previously made.

2. On Creosote.—By the experiments of Mr. Fairlie and Mr. Scrugham[5] it has been pretty well demonstrated that "commercial creosote is mainly a mixture of two homologous bodies, namely, hydrate of phenyle, or carbolic acid, and hydrate of cresyle." The former of these boils at 184° C. the latter at 203° C. Their formulæ differ by the ordinary increment C_2H_2, and are—

Hydrate of Phenyle	$C_{12}H_6O_2$
Hydrate of Cresyle	$C_{14}H_8O_2$

Mr. Fairlie observed that during the distillation of hydrate of cresyle it suffers partial decomposition; the liquid becomes dark in colour, a little water is given off, a small quantity of creosote comes over at a lower boiling point, and a black residue remains in the retort. He believes it to be then partially converted into hydrate of phenyle.

For the experiments of Mr. Dale and myself on refractive indices, I prepared these two substances from creosote by fractional distillation. Several of the distillates were set aside, some with pieces of chloride of calcium immersed in them with a view to remove the water which hydrate of phenyle readily absorbs, and which prevents its crystallising. When these specimens were examined about a year afterwards it was found that all those which contained chloride of calcium had become of as deep a red as port wine, and some of them deeper, while those which had stood without that addition were little altered in colour.

Supposing, therefore, that the chloride of calcium was effecting the same change in the creosote that heat is known to effect, I allowed the specimens to remain longer as they were, and I placed a portion of clear creosote, consisting of the mixed hydrates, in a bottle with some dry chloride of zinc. About five months afterwards all the specimens containing the chloride of calcium were found to have become darker in colour, and in two cases the deliquescent salt had become entirely liquid. The chloride of zinc also appeared partly dissolved in water, and the creosote above it was dark red. One portion, which had been distilled originally at between 200° and 210°C. and which had stood over chloride of calcium, was submitted again to distillation; nearly the whole passed over now at between 190° and 200° C. leaving a black viscid matter behind. It may be concluded, therefore, that these hygroscopic salts determine the conversion of hydrate of cresyle into hydrate of phenyle with the separation of water, and the formation of some more highly carbonised product.

An elevation of temperature, as might be expected, hastens this action.

A depression of temperature facilitates the crystallisa-

[5] *Quart. Journ. Chem. Soc.* vii. 232 and 237.

tion of hydrate of phenyle from the liquid standing over chloride of calcium. A good method, in fact, of obtaining this substance from good commercial creosote, is to add a piece of chloride of calcium to the liquid, so as to remove the combined water, and, after the lapse of a few days, to subject it to a freezing mixture.

3. On a Compound of Molybdenum, Chlorine, and Fluorine.—While investigating the laws of reciprocal decomposition, I prepared some green molybdous chloride by dissolving the oxide in hydrochloric acid, and in my paper on the subject[6] I state:—"The addition of hydrofluoric acid to this gave, at the first moment, a rich purple, which was immediately succeeded by a white precipitate, insoluble in any excess of hydrofluoric acid, but readily soluble in hydrochloric acid, with the reproduction of the green." This white substance is a compound of molybdenum with both the halogens, and I made the following additional observations upon it at the time:—

It requires a large excess of hydrofluoric acid to precipitate the body in question, to its full extent, from a solution of the chloride. It then presents a crystalline appearance, but is insoluble in water, and does not contain any water of crystallisation.

When boiled in water, a certain decomposition takes place, molybdenum and chlorine in some manner of combination appearing in the liquid, and a heavy white powder being formed at the expense of the crystalline salt.

When heated *per se* in a glass tube, the crystals fuse at a temperature approaching redness, a white sublimate ensues, and the fused salt turns yellow and attacks the glass. The sublimate is not readily soluble in water, but it does afford a solution which gives indications of chlorine, and from which ammonia throws down a white flocculent substance.

The compound under examination dissolves readily in dilute nitric as well as in hydrochloric acid. From its solution in the former, nitrate of silver causes a precipitate of the chloride. If ammonia be added to the nitric acid solution, a white flocculent precipitate ensues, and the liquid contains a chloride, but no fluoride, and nothing which is not volatile when heated to redness. This reaction was repeated quantitatively, when it was found that the precipitate, on adding ammonia, after being dried at 100° C. weighed within 0·5 per cent. of the original crystals, so that it appeared that the elements of ammonia or water must have combined themselves in some way with the substance during decomposition, for the chlorine found in solution amounted to 11·50 per cent. It is probable enough that this weight was not the whole of the chlorine contained in the original compound.

When this substance is treated with sulphuric acid at the ordinary temperature, solution takes place slowly, with the evolution of a gas somewhat resembling chloride of sulphur in its smell. If heat be applied, hydrochloric acid is given off, and hydrofluoric acid, evidencing its presence by etching glass, and some compound of molybdenum.

Ammonia does not dissolve or decompose the solid crystalline body, but it is dissolved in potash. From this solution hydrochloric acid reprecipitates it, or at least some white substance, which redissolves on adding a larger excess of the acid. A piece of metallic zinc immersed in this solution precipitates molybdous oxide.

[6] *Phil. Trans.* 1855, p. 208.

Note on the Spontaneous Oxidation of Oils, including the Centesimal Composition of Oxidised and of non-oxidised Cod Liver Oil, by J. Attfield, *Demonstrator of Chemistry at St. Bartholomew's Hospital.*

The subject of the spontaneous oxidation of oils having been so thoroughly investigated, first by Saussure, but particularly by Chevreul[1], I should not have drawn further attention to the matter had not an experiment presented itself that seemed peculiarly favourable for confirming some of the results obtained by these chemists.

About ten years ago my friend Mr. Robbins divided a specimen of good cod liver oil into two portions; the one he placed in a well corked and carefully sealed bottle, the other in a bottle the mouth of which was merely covered over with muslin, and which, therefore, admitted of free action of air upon the oil; both were finally deposited on a shelf open to diffused light, but not to the direct rays of the sun. Now, as cod liver oil belongs to the drying or siccative subdivision of oils, it occurred to me that here was an excellent opportunity of proving, not only that such oils absorb oxygen when exposed to the air, but also the extent to which oxidation takes place under the circumstances narrated. The centesimal composition also of a pure oil, and of the same oil after spontaneous oxidation, seemed quite worthy of being placed on record. Mr. Robbins having favoured me with portions of the specimens referred to, I proceeded to examine them, and the following are the results I have arrived at:—

The Pure Oil.—In colour, odour, and taste, it presented all the characteristics of good cod liver oil, and contained the following amounts of carbon, hydrogen, and oxygen in one hundred parts:—

Carbon	77·00
Hydrogen	11·28
Oxygen	11·72
	100·00

The same oil, after drying over chloride of calcium, gave—

Carbon	77·44
Hydrogen	11·27
Oxygen	11·29
	100·00

The above numbers show that the oil had lost about four-thousandths of its weight of water, a result that might have been expected from the well-known property possessed by oils of retaining small quantities of that liquid.

The Exposed Oil.—By transmitted light it was quite transparent, but by reflected light exhibited a greenish bloom, resembling that of well boiled linseed oil, and was apparently semi-opaque. Its dark red colour contrasted strongly with the pale yellow of the pure oil; its odour and taste was that of fish in an advanced state of decomposition, and its consistency was such that it could scarcely be made to flow from one vessel to another. Its centesimal composition is thus represented:—

Carbon	71·39
Hydrogen	10·29
Oxygen	18·32
	100·00

The same oil, after drying over chloride of calcium, lost about one and a half per cent. of water. On close examination, however, of the undried specimen of the oxidised oil, I was led to think that the greater part of the

[1] *Ann. de Chim. et de Phys.* 3e série, xlvii. 209-283.

water was in the state of mechanical suspension, and this opinion was confirmed when Mr. Robbins told me that on one occasion a small quantity of water had by accident got into the bottle. The following is a statement of the composition of the dried specimen:—

Carbon	72·71
Hydrogen	10·14
Oxygen	17·15
	100·00

Taking now the dried oil as the basis of calculation, it will be seen that cod liver oil, of a given centesimal composition, has, by ten years' exposure to air and diffused light, lost 4·7 per cent. of carbon, and 0·82 per cent. of hydrogen, and has gained 5·52 per cent. of oxygen. This change may be accounted for as follows:—

First. That 100 parts of the oil simply have absorbed about 5½ parts by weight—or 51·6 times their volume—of oxygen gas; or,

Second. Bearing in mind that, while some drying oils absorb oxygen but evolve neither carbonic acid nor hydrogen, others absorb oxygen and evolve both carbonic acid and hydrogen, it will be found on calculation that the change may be explained by supposing that 100 parts of the pure oil have absorbed 18·05 parts by weight—or 143 times their volume—of oxygen, and have generated 17·23 parts by weight—or 95 times their volume—of carbonic acid, and 0·82 parts by weight—or 104 times their volume—of hydrogen.

By either of these theories an oxidised oil would be obtained of the following composition, which, it will be noticed, closely corresponds with the numbers already given:—

Carbon	72·68
Hydrogen	10·29
Oxygen	17·03
	100·00

It must be observed, however, that these theories only represent the opposite extremes of a very long series of changes, any one of which may have taken place. For instance, direct absorption of oxygen may have only partially acted in reducing the percentage of the other elements; evolution of carbonic acid and perhaps of hydrogen accounting for the remainder of the loss. These points can, of course, only be determined by further experiment.

The more important fact, however, that the drying, or rather solidification, of oils is accompanied by absorption of oxygen is, by the above experiments, interestingly confirmed: at the same time extent of oxidation is well indicated.

I have appended the following table in order to show the relative centesimal composition of cod liver and of other oils, as well as the difference, in that respect, between oxidised and non-oxidised cod liver oil:—

Oil.	Carbon.	Hydrogen.	Oxygen.	Authority.
Olive .	77·21	13·36	9·43	Gay-Lussac and Thénard
Almond	77·40	11·48	10·82	Saussure
Linseed	76·01	11·35	12·64	Saussure
Nut .	79·77	10·57	9·12	Saussure
Castor .	74·17	11·03	14·78	Saussure
Whale .	76·13	12·40	11·50	Berard
Sperm .	78·91	10·97	10·12	Ure
Cod Liver	77·44	11·27	11·29	Attfield
Cod Liver (oxidised)	72·71	10·14	17·15	Attfield

Saussure found traces of nitrogen in some of the specimens he examined; that element, however, is only present in oils that have only been imperfectly purified.

TECHNICAL CHEMISTRY.

Report on Communication from Dr. Letheby, with Reference to the Quantity of Arsenic in Perchloride of Iron, by Dr. HOFMANN, *F.R.S. and Dr.* FRANKLAND, *F.R.S.*

SIR,—Having perused a letter addressed by Dr. Letheby to Mr. Deputy Harrison, to which you called our attention, we now beg leave to express our opinion upon the subject of that communication.

Dr. Letheby states in his letter that he has found in the gallon of "Dales' Perchloride of Iron" not less than 238 grains of chloride of arsenic, adding at the same time that this quantity "is sufficient to poison about forty persons," and "that the form in which the arsenic exists in the liquid is one of the most dangerous of all the compounds of arsenic—far more dangerous than the common white arsenic." He concludes with mentioning that his object "is to warn against the use of so frightfully dangerous a liquid," since, "according to the report of the chemical referees (August 12th, 1859, p. 6), every 1,000,000 gallons of sewage would require 66 gallons of the perchloride to disinfect them, a quantity that contains enough arsenic to kill 2640 persons; and if the whole of 80,000,000 gallons of a day's sewage were so treated, it would be necessary to cast into the Thames every day nearly 180 lbs. of one of the most dangerous preparations of arsenic."

The perchloride of iron manufactured for disinfecting purposes almost invariably contains a small quantity of arsenic, which is derived from the iron ores used in its preparation. We have carefully examined the perchloride used in our experiments on deodorisation, to which Dr. Letheby refers, and find that it contains 52·1 grains of arsenic in the imperial gallon, which, expressed as chloride of arsenic, amounts to 125·9 grains; from which it is evident that the liquid we worked with contains but little more than one-half of the quantity present in the sample examined by Dr. Letheby.

We lay but little stress upon the difference of results furnished by the experiments of Dr. Letheby and those made by ourselves, for it is our deliberate opinion that even were the perchloride of iron to contain ten times the maximum quantity of arsenic observed by Dr. Letheby, its application for the purposes contemplated in our Report could not afford grounds for the slightest apprehension of danger.

This our opinion is based upon the following considerations:—

It is well known that the most efficient antidote of arsenic is the hydrated peroxide of iron, such as is produced by the addition of alkaline liquids to perchloride of iron. The action of this antidote depends upon the formation of a compound of white arsenic with peroxide of iron, which is perfectly insoluble in water, and consequently absolutely innocuous. Now, it will be observed that the addition of the perchloride of iron to sewage, which is a liquid of an alkaline character, involves the conditions for the production of an amount of this antidote, immensely greater than that necessary for the complete precipitation of the arsenic contained in the perchloride.

The ultimate plan of dealing with the sewage contemplated by the Board, consisting, as it does, in collecting the sewage in settling reservoirs, and filtering off the deposit formed after the addition of perchloride of iron, it is obvious that this mode of proceeding completely excludes the possibility of the Thames becoming contaminated with arsenic. Although there could not exist

any doubt in our minds upon this latter point, we nevertheless considered it of sufficient interest to submit it to the test of direct experiment. Sewage freshly taken from the Fleet sewer, and mixed with the proportion of perchloride of iron recommended by us for deodorisation, did not, after filtration, contain a trace of iron, and careful experiments, made with the most delicate tests, failed to detect even the most minute trace of arsenic, proving that the whole had been precipitated and removed from the liquid by the peroxide of iron, formed by the action of the sewage upon the perchloride of iron.

The deposit formed during the subsidence contains the arsenic in a perfectly innocuous form, and, moreover, diluted to such an enormous extent that the last grounds of apprehension entirely disappear.

A very extensive series of experiments give 30 grains as the average amount of suspended matter in a gallon of London sewage. Now, supposing that the addition of perchloride of iron to the sewage gave rise to the deposition of this suspended matter only—whilst, in reality, it at least doubles that amount—the quantity of arsenic as resulting from Dr. Letheby's experiments, viz. 180 lbs. of chloride of arsenic, corresponding to 98 lbs. of ordinary white arsenic, would be diffused in 342,857 lbs. of material, constituting the daily deposit from the London sewage; or one part of arsenic would be mixed with 3000 parts of solid matter.

It is, perhaps, of some interest to compare with this result the amount of white arsenic in some deposits from water which occur in nature.

Modern chemistry has proved that arsenic is much more extensively diffused than was formerly supposed, the ferruginous deposits from the majority of mineral waters having been found to contain this substance in appreciable quantities. M. Daubrée, a French chemist, who has been engaged in experiments upon this question, has even succeeded in proving the presence of arsenic in sea water. We may here limit ourselves to quoting the proportion of arsenic contained in the deposits of some of the most celebrated mineral springs.

Name of deposit.	One part of white arsenic in
Wiesbaden, as determined by Fresenius (deposit in basin of well) . . .	961 parts.
(deposit in the pipes) . . .	67 „
Carlsbad (deposit in well) . . .	278 „
Deposit from London sewage, deodorised by perchloride of iron . . .	3000 „

But let us now consider what will be the influence of the arsenic in perchloride of iron, supposing this agent to be used for deodorising the sewage flowing without subsidence into the Thames, such as contemplated by the Board until the necessary arrangements for the ultimate disposal of the sewage are completed. It is obvious that the perchloride of iron must affect the sewage exactly as in the previous case, and that the whole of the arsenic will exist in the insoluble or innocuous form before the contents of the sewers are discharged into the river; the only difference then being that the innocuous deposit will in the latter case be carried into the river, whilst under the former circumstances it would be retained upon the filter beds.

Now we cannot think that a deposit containing not more than one part of arsenic in 3000 parts of matter, when further diluted with the whole bulk of the river, need cause any serious apprehension. But we may go a step further, and assume for a moment that the whole of the arsenic contained in the daily supply of perchloride of iron could penetrate into the Thames in the soluble or poisonous condition. The average volume of water which passes Richmond daily is calculated to be 800,000,000 of gallons, and if we add to this the supplies which the river receives in its progress to London by tributaries and sewers, we are probably not far from the truth if we estimate the daily volume of water passing the metropolis at 1,000,000,000 of gallons. If the daily quantity of white arsenic, taking as the basis of the calculation the estimate of Dr. Letheby, be diffused through this volume of water, there would be contained one grain of white arsenic in 1450 gallons. The Wiesbaden water, which is generally considered a wholesome water, contains one grain of white arsenic in 166 gallons.

The following considerations may perhaps assist in restoring the equilibrium of the most timid. The daily average consumption of water, as such, and in the form of bread and beer, by an adult, may be fairly estimated at about half a gallon; but supposing an individual, blessed with so thirsty a constitution as to require a gallon, it is obvious that ten years would not have been sufficient to supply him with an amount of arsenic which, if administered in one dose, would prove fatal, and that a quantity of 3¼ tons of coal would be required to evaporate Thames water into a potable bulk containing an equal quantity of white arsenic.

It is thus evident that the extreme dilution which the arsenic contained in the perchloride of iron suffers in becoming mixed with Thames water, is alone sufficient to exclude the very idea of danger, even if this arsenic had not been converted, as we have shown it to be, into a perfectly innocuous compound before it reaches the river.—We are, &c.

(Signed) A. W. Hofmann.
E. Frankland.

To the Chairman of the Metropolitan Board of Works.

PHARMACY, TOXICOLOGY, &c.

On the Preservation of Lemon Juice, by Julius Schweitzer.

The expressed juice of the lemon is of an opaque pale yellow colour, a pleasant strongly acid taste, and consists of citric and malic acids, vegetable mucilage, extractive bitter, aromatic principles, and water. Pleasant as the fresh expressed juice is as a cooling beverage in the form of lemonade, its principal and most important application is in scorbutic eruptions on the high seas. It is easy for medical men in large towns to order one or two ounces of *succus limonis recentis*, which is readily prepared by the dispenser, and we never hear any complaints about the inefficiency when so administered. But it is far otherwise with those that travel by sea, where hard work, exposure to cold, wet, and only salted or bad provisions, produce at last that overwhelming scourge the scurvy. No fresh lemon juice can here be obtained, and that which was shipped as such only too often turns out spoiled and unfit for use. We frequently hear of these cases, and great as the evil becomes in consequence, it is surprising how very little has yet been done to prevent repetitions of these calamities. The public, usually satisfied with heaping blame upon somebody, imagines to have done its duty, after having severely commented upon the carelessness of the shipper and the nefarious contractor, with what result the next case usually illustrates. Fresh lemon juice, as we have already mentioned, is a solution of vegetable acids and mucilage, two things very liable to spontaneous decomposition.

Vegetable acids, even when dissolved in distilled water, readily split up and form new and sometimes widely different compounds — a change which takes place far more speedily in solutions containing other decomposable vegetable matter besides. Citric acid and water is easily converted into acetic acid, and it would be just as possible to preserve a weak solution of sugar and yeast as to keep crude lemon juice for any time unchanged. The citric acid decomposes, fungi are formed, and the whole passes into the putrid fermentation, and how injurious such a compound must prove when administered to persons suffering from scorbutic disease may well be supposed. All this is by no means new; on the contrary it was known long ago, and various modes were suggested to prevent this speedy decomposition from taking place, but, as it appears, with but little success. The author has made a series of experiments with fresh lemon juice, the results of which may perhaps be of some interest.

Pharmaceutists generally look with suspicion and dislike on turbid or cloudy liquids, usually caused either by bad manipulation, imperfect condition of one or more of the ingredients, and in all cases indicating an unnatural or overcharged solvent. Such liquids are always liable to subsequent changes. The fresh turbid juice of the lemon filters with the greatest difficulty, and the filtrate is never bright. Vegetable juices may frequently be clarified quickly and effectually by boiling. Lemon juice so treated filters more readily, but still remains slightly turbid. When filled into bottles and corked while still warm it will keep better than ordinary juice, but ultimately fungi appear quite in the interior of the liquid, which gradually grow and spread till the whole is altered and spoiled as before. Hermetically sealed bottles would be besides a great inconvenience or practical impossibility for exporting large quantities, neither does a layer of oil over the liquid, preventing the access of air, lead to any better results, as decomposition will take place without the influence of the atmosphere. Alcohol, the best preserver of animal and vegetable matter, was next tried and samples of fresh lemon juice mixed with from 1 to 10 per cent. of rectified spirit. These various mixtures become more or less bright, and as might be expected those with the least alcohol commenced gradually to decompose. Those, however, containing the largest amount were well preserved; and we are at present in possession of specimens of lemon juice which, by means of 10 per cent. of rectified spirit and kept under quite unfavourable circumstauces in only half-filled bottles, have maintained all their original goodness. The fresh expressed juice when mixed with the above 10 per cent. of alcohol readily becomes clear, is easily filtered, of a bright pale straw colour, of agreeable sour taste, and perfectly suitable for exportation or naval use. The addition of alcohol will slightly increase the cost, but as the juice keeps good while the other spoils and has continually to be renewed it is questionable which after all will prove the cheapest; neither is the higher price of any consequence when compared with the medicinal importance it is sometimes, and usually under the most critical circumstances, called upon to fulfil.

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The Antimony Poison Cases.

The following is the chemical evidence given in the case of Thomas Winslow, who is charged with causing the death of Anne James by the administration of antimony. The deceased, it will be remembered, had been some time in bad health, and was attended by Dr. Cameron. Repeated and violent attacks of vomiting and purging led the Doctor to suppose that his patient was the victim of foul play. By his request, therefore, she was removed to the Southern Hospital at Liverpool. There she was occasionally visited by the prisoner, who sometimes took the opportunity of giving her food, which on each occasion was followed by a return of the vomiting and purging. She died on the 24th of June, and a *post mortem* examination revealed the existence of cancer of the cœcum, with two perforations of the intestine, which latter were the immediate cause of her death. A chemical examination of different parts of the viscera and other matters disclosed the presence of antimony, as detailed below:—

"Dr. Edwards described in great detail the results of the analysis which he had made of the vomit, fæces, and urine of the deceased, during the time that she remained an inmate of the Southern Hospital. On some days all the evacuations yielded considerable antimonial deposits, on others none at all; while there were occasionally traces of antimony in the fæces and urine when there were no traces in the vomit. Antimony was found in a small quantity of cooked sago, but none in the uncooked sago. From one half of the stomach of the deceased he obtained five antimonial deposits; more than one half the intestines yielded antimonial deposits; one kidney yielded four deposits; two pounds of the liver three deposits; in the brain no trace was found. Three ounces of bile yielded no antimony; in four ounces of blood a distinct deposit was observed. From a pint of fluid in the stomach a considerable quantity was obtained. Twelve ounces of fluid from the peritoneal cavity yielded a slight trace. On the 3rd of July he received from Inspector Horn certain medicines (prescribed by Dr. Cameron), but found no antimony in them, nor in the wine found in the house. The deposits to which he had alluded were the thin films of antimony which became precipitated upon the surface of the copper when the metal was present.

Dr. Alfred Swaine Taylor was next examined. On the 10th of July he received at Guy's Hospital a portion of the stomach and intestines of the deceased, which he analysed. With the exception of the spleen and lungs he divided the viscera, and delivered one half to Dr. Miller. He examined a portion of the viscera for antimony and arsenic, and found antimony clearly in the spleen, lungs, and liver. The other portions of the viscera did not yield any decided traces. He examined the spleen in the presence of Dr. Edwards and Dr. Miller. He also examined the deposits on copper produced by Dr. Edwards, and some sublimate on glass obtained by Dr. Edwards in his analysis of the viscera. They were derived from some compound of antimony present in the body of the deceased. Finding antimony diffused through these organs, he formed the opinion that it had been taken during life. From an examination of the viscera there were no appearances which would lead him to suspect the cause of death, except a cancerous disease in the cœcum. He adopted the same mode of analysis as Dr. Edwards had described, and they were all equally satisfied that the deposits and sublimate were due to antimony. From what he had heard as to the deceased's symptoms, and from his own experiments, he should judge that death had been caused by rupture of the diseased cœcum. The vomiting and purging might be produced from small doses of antimony, and hearing that antimony was found in the vomited matter as well as in the fæces, he should attribute these symptoms to the ad-

ministration of antimony, but how far that contributed to the death of the deceased he found it impossible to give an opinion. There was extensive disease of the cœcum with ulceration of the stomach, and antimony given to a person labouring under chronic disease of this nature would be likely to cause great exhaustion and to accelerate a fatal termination.

By Mr. Cobb.—The symptoms more or less which he had described might arise from the disease under which the deceased laboured. Disease of the cœcum was more commonly attended with purging and ulceration of the stomach, with vomiting; but the difficulty which he had to account for was the presence of antimony in the matter vomited. Small doses of tartar emetic would irritate the mucous membrane, and if frequently repeated might cause inflammatory redness of the stomach and bowels.

Dr. Cameron recalled.—Having heard the chemical evidence as to the finding of antimony in the body of the deceased, I now attribute the immediate cause of death to perforation of the bowels, but from the finding of antimony in the matters vomited during life, and in the matters passed from the body, together with the symptoms under which the deceased laboured, and the extent to which antimony was found in the body after death, I am of opinion that Mrs. James's death was accelerated by the administration of some preparation of antimony during life. It is my impression that she would not have died so soon but for the administration of antimony."

The prisoner was committed to take his trial for "wilful murder."

Another very suspicious case has occurred at Yeovil. A Mrs. Peters suffered from symptoms which induced her medical attendant, Dr. Garland, to examine some of her evacuations, in which he found traces of antimony. He then forwarded some of her urine to Mr. Herapath, who detected antimony in it. She was afterwards seized with violent pains in the abdomen, and died on the 5th of July. No antimony was found in the stomach or intestines after death. It may be important to remark that in this, as well as the Liverpool case, the immediate cause of death was perforation. The condition of the stomach and intestines generally was said to have been such as might be produced by the action of an irritant poison. To account for the absence of antimony from the viscera, Mr. Herapath conjectured that all had passed away, and observed that it has not yet been discovered how long antimony will remain in the system.

While on this subject, we may quote the conclusions at which Kletinsky arrived after a series of experiments on the excretion of arsenic and antimony in the urine:—

1. That the excretion of both arsenic and antimony in the urine may take place in the form of their alkaline salts, and that in the case of poisoning by arsenic the presence of a small quantity of albumen in the urine is indubitable, but is problematical in the case of antimony.

2. That the excretion takes place a short time after the administration of arsenic, and continues uninterruptedly till death or recovery, but that in the case of antimony it is slower, and usually continues for a longer time than in the case of arsenic.

3. That the analysis of the urine, in cases of poisoning by arsenic or antimony, provided the patient live for from 12 to 24 hours, is capable of furnishing a complete negative or positive conclusion.

Arsenic Eating.

Seven reports have recently been drawn up by physicians residing in the north and north-west districts of Styria, where arsenic eating is of common occurrence. In the arrondissement of Hartberg alone there are forty persons addicted to this practice. In general they use only the white or yellow arsenic sold by the druggists, or that found in the natural state as orpiment. The dose, which at first is not larger than a grain of millet, is gradually increased until it becomes as large as a pea, varying in weight from two to as much as five and a half grains. Some persons take their dose daily, others one every two days, and others again not more than once or twice a week. At Hartberg it is usual to refrain from arsenic during the first seven days of the new moon, and then to begin and gradually increase the dose to the full moon. After taking arsenic it is necessary to avoid strong drink, meat, and dishes prepared with fat. Persons of advanced age feel a pleasant warmth in the stomach immediately after taking their usual dose. Most of the arsenic eaters are strong, healthy, hard working people, such as woodmen, labourers, grooms, and forest keepers. Many begin to practice it at eighteen years of age, and continue it all their lives, which are often protracted to seventy, and upwards. The men who have acquired the habit are, for the most part, daring and rather quarrelsome. They imagine that arsenic makes them strong and healthy, and prevents the attacks of disease generally, notwithstanding the fact that many of them sink into a state of languor and debility. These virtues came to be attributed to arsenic, owing to the beneficent effect it appeared to produce on horses, which became fat and sleek after it was administered.—*Gegenwart, Vienna Journal.*

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Products in the Museum, by Edwin Lankester, *M.D. F.R.S.*

Lecture VI. *On Waste.*

"Gather up the fragments—let nothing be lost," is a divine injunction for us in every age. We recognise it most strictly, I hope, with regard to our food, but, perhaps, we are not so particular with regard to the fragments that are likely to be lost in our manufacturing operations. I want to show you that if we imitate in our manufacturing processes the great laws of nature we shall save much, and we shall also diminish our labour and multiply our sources of happiness on the earth. We can see it in some things more obviously than in others. We can see it in the mineral world. When the workman is at work on the diamond he suffers not a grain of its dust to be lost or wasted, but hoards it up for future use. So with the workmen in gold and silver. We find that the particles of dust that escape in various directions are carefully collected; and it is not less true with regard to vegetable products. We see the shavings and sawdust of the carpenter and cabinet-maker carefully collected together for other purposes and uses in the arts and manufacturing operations; and it ought to be no less so in the animal kingdom, in the use of the animal products.

There is an anecdote told of a distinguished chemist, who was asked how he had made his great discoveries, and he replied that it was by examining that which other chemists threw away. So many a manufacturer makes his fortune by using that which others throw away.

I purpose first to examine some of the substances which, on account of their physical properties, are now recovered,

and which at one time were regarded as waste. I spoke to you first of silk, and I referred to the way in which the silk is wound off the cocoons, and how it is rolled and afterwards spun, and formed into a variety of garments.

During the operation of spinning there is a quantity of loose silk, which would be entirely lost but that pains are taken to collect it in a rough state; it is then pulled out, and the fibres again reeled, and it is manufactured into the lower kinds of silk. The waste of this process is collected again, and again it is re-reeled and wound; so that not a fibre is lost. After the silk of the cocoons has been wound off, there still remains a quantity of silk upon the used cocoon. which, under the name of "knubs and husks," is imported into this country. The knubs and husks are torn to pieces, and the fibre is reeled and woven into the lower sorts of silks; so that there ought to be no waste in silk at all.

I pass on from silk to wool. During the process of spinning and weaving wool there is a quantity of waste — a quantity of the hair is left; but this is now collected, and applied in a variety of ways. Some of the better kinds of this waste wool can be used and mixed with higher sorts, and are thus worked up. We find that after the cloth is woven the ends are cut off, under the name of *list*, which is again torn to pieces and re-wound. There is also from such waste portions an extensive manufacture carried on of the substance known by the name of flock. The wool is ground down to a powder, and mixed with colouring matters, such as vermilion for red, chromate of lead for yellow, arsenite of copper for green; so that the flocks assume a variety of colours; and these coloured flocks are used for the purpose of manufacturing what are called flock-papers. The paper is figured in a variety of ways, and the figures are covered over with size or gum, and the flock is powdered over it: it is then called flock-paper. This process was first patented by a Frenchman named Lanyer in 1634, and since his time there has been a considerable manufacture of flock-papers in this country. It has, however, reached great perfection on the continent, and the French have paid particular attention to the patterns. These flocks then have been produced by the refuse of the woollen manufacture.

I would here say one word with regard to the colouring matters of flock-papers, as it is a matter of importance. They should not be mixed with poisonous substances. The greens are mostly made with arsenite of copper; and instances have not been rare of persons living in rooms where these green flock-papers have been used; and the consequence has been that when the paper has been brushed the particles of arsenite of copper have got into the air, have been taken into the lungs, and produced injurious effects on the system. I do not know that it is so deadly a thing as represented, but it seems an imprudent thing for people to live in rooms covered with these green papers. Wherever these flock-papers are used they accumulate a greater quantity of dust than other papers, and consequently require to be brushed oftener. It is undoubtedly much the most wise and prudent plan in the case of paint, and in the case of all substances employed in rooms where persons live that they should not contain poison.

Now let me draw your attention to the fact that the wool, after it has been used—after it has been worn, has its analogue in the rags of linen and cotton clothing. You know how desperate has been the condition of the paper manufacturer because he cannot get a supply of rags for his manufacture. The woollen manufacturer has been saved from the same state by a material which is produced under the name of "shoddy," and which is extensively used in the manufacture of clothing of common quality, such as pilot coats, ladies' mantles, druggets, and the cheaper kinds of carpeting. This material is not made of new wool, but of cloth that has been worn and afterwards torn to pieces by machinery. This shoddy has various prices in the market according to the substances from which it comes, and there are now shoddy markets just as there are woollen markets, and the shoddy markets are increasing every day. One principal seat of this manufacture is Dewsbury in Yorkshire. It has, however, found its way into Leeds, Wakefield, and to all the large woollen manufacturing towns. Those who are skilled in the knowledge of real woollen cloth can easily distinguish between it and shoddy. This trade has been sometimes objected to on account of its appearing to produce an article of a superior kind with an inferior raw material; but, after all, you will find that these shoddies are not sold at the price of superfine cloths, and are good substitutes for them. The cheap clothing of late years has depended upon the introduction of this shoddy, and, provided the price is not larger than gives the fair profit to the manufacturer, we cannot object to it as it enables many a man to put on, at least once a week, a decent-looking coat who otherwise would not have a cloth coat at all; and if the wear only answers to the price given I do not think any one can find fault.

Passing on from shoddy to leather clippings, I will mention that a patent has been recently obtained for cutting up the clippings of leather, and introducing them into the soles of boots and shoes, rendering them easier to the wearer and quite as durable; thus saving new material. Leather cuttings are also employed in the manufacture of prussian blue.

I have hitherto been speaking of the physical properties of waste substances; but waste matters are composed of chemical elements, which can be changed into other compounds by which we can get new substances; and some of our most extensive manufactures depend on this fact. All the substances of which I have spoken — the clippings of leather and [the fibres of wool and silk — whatever animal substances we may have have, are composed of the four elements—carbon, hydrogen, oxygen, and nitrogen. We find all these elements in carbonate of ammonia. Now the difference of elements, as they exist in the carbonate of ammonia, and as they exist in bones, or in hoofs, or in horns, or in wool, or in skin, is this—that the elements of the animal body are much more easily changed, and more readily made to assume combinations which are useful to man than if he had to deal with mineral compounds. Hence it is that he prefers to work chemically at the gelatine or wool, or some other constituent, than to take carbonate of ammonia, which is cheap enough but not the easiest to work with.

I will now speak of skin waste. The tanner has waste. While he is preparing his skins, he cuts off the fat and the portions which cover the legs and the ears. The oil and the fat are sold to those who boil down oils and fats of all kinds. You will recollect that the oils and fats can be made into soap; and it is no matter whether the oil or fat be obtained from skins or from other sources. Then again this oil and this fat, obtained from the tanners' waste, is made to yield its stearic acid. Its glycerine may be obtained for all the purposes to which it can be applied, and its stearic acid may be manufactured into candles. The bits of skin are carefully collected and boiled down with various other odds and ends obtained from various sources. They are bought by the manufacturer, and are placed in large vessels and boiled in water, and thus they are made to yield gelatine. The oil contained in those substances floats to the top. If the manufacturer wants a coarse and common tallow, it is employed as it is taken off; but if you are to have a better kind, it is afterwards prepared with great care. The water being evaporated, the gelatine is then procured. If the gelatine is to be used as size in the arts, it is less carefully prepared than if it is to be sent to your table as isinglass; and, let me tell you, whether you get the isinglass from the sounds of the sturgeon or from these things, it is all the same to you; for they are boiled down and purified, and can do no harm. The manufacturer of gelatine asks no questions, and perhaps it is prudent that you should ask none, and then if you are indulged with the taste of a leg-bone or an arm-bone of an old friend, you cannot help it. Well, this gelatine is certainly a very interesting substance, on account of the great variety of forms it assumes, according as it is prepared carefully or not. When it is used in the

arts for adhesive purposes, as in the form of glue, it need not be so destitute of colour or so carefully prepared. On the continent it is now manufactured into all kinds of forms. Large sheets are made for the purpose of colouring glass, for cutting up and forming into artificial flowers. It is used for the internal ornamentation of buildings, and for the wrappings of sweet-meats. Those who are in the habit of cracking *bonbons* at the supper-table will recollect that they are wrapped up in this coloured gelatine. This manufacture is entirely dependent upon the use of what was a few years ago regarded as waste material.

I now come to the waste in bones. I mentioned that buttons were made of bones, and handles of knives and a variety of useful articles are made of bones. The buttons are punched out of the bones, and the pieces that are left are not lost. The dust made in sawing bones is collected; and butcher's bones and household bones are all used. They are first boiled down, and the fat is taken off, as in the case of the skin, and then their gelatine is dissolved, and the gelatine is used for glue, or size, or isinglass. In the bone that is left, there is still useful material, which may be employed for various purposes. The refuse of the bone-boiler is now commonly introduced into a closed furnace, by which a peculiar kind of animal charcoal is produced. So you see that after they have made buttons, they are used for making size, gelatine, jelly, soap, and candles, and then they are still available for making animal charcoal. This charcoal, for many things, is better than any other; and this raises the question why this is the best? There is another form of animal charcoal obtained from burning blood, and which may be considered the best animal charcoal, because it contains the largest quantity of carbon; but it is found that this bone charcoal is better for filtering purposes than the ordinary animal charcoal, and at this moment it is fetching a higher price in the market. It is used especially for filtering water and refining sugar. You know that sugar is brought into this country in a brown state. Here it is melted and purified by passing through animal charcoal. One filtration is not sufficient, but a second is; and the charcoal which is found to be most efficient is this charcoal which is made from the refuse of bones after all the gelatine and fat have been extracted. It is probably, then, not so much the carbon which strains and keeps out this organic matter as the phosphate of lime. Now, I do not mean to say that anyone would make a fortune by it, but it is worth consideration whether common vegetable charcoal mixed with phosphate of lime may not answer as well. Here, perhaps, we may inquire how it is that these charcoals act as purifying agents. I may say that this purifying action is not confined to water and sugar, but that chemists use animal charcoal as a means of purification for a variety of processes. It would seem, with regard to the water, that the animal charcoal has a power of absorbing and holding, and as it were introducing oxygen to the impure substances contained in the water, so that they become oxidised and converted into something else; for we find that the animal charcoal retains its power of purification for several years. If, instead of oxidising these substances and passing them through, it acted as a strainer or sieve, straining out the impure materials, then you would have the charcoal blocked up; but it is not so. These impure substances in water are all composed of carbon, hydrogen, and nitrogen. The oxygen oxidises the carbon, and forms carbonic acid gas, which makes the water sparkling and refreshing. It oxidises hydrogen, and converts it into water: it oxidises nitrogen, and converts it into nitric acid; and thus the impurities of the water are converted into substances which may be consumed without any injury whatever.

This, I think you will say, is a most remarkable instance of the application of waste to important purposes. This has really arisen out of the necessities of the bone-boilers, who, when they had obtained the fat and gelatine out of the bones, left them to accumulate and engender and send forth a smell of sulphur and ammonia, and other compounds, which made people object to the annoyance of bone-boiling houses near to them; and now, instead of allowing these bones to lie and produce these ammoniacal compounds, they are at once thrust into a furnace, and converted into charcoal. Now, these things encourage us to go on. Let us not be beaten by bad smells. All these substances which throw out disagreeable odours—all these may be conquered and made to serve our highest and best purposes in life. The very sewers' smells, which are so injurious in the summer season of the year in this metropolis, even these may be made to form compounds with other substances, which, being conveyed on to the land, actually fertilise it; and the compounds of carbon, oxygen, hydrogen, and nitrogen of the sewers become the compounds which feed us.

(*To be continued.*)

NOTICES OF BOOKS, PATENTS, &c.

An Introduction to Practical Pharmacy: Designed as a Text-book for the Student, and as a Guide for the Physician and the Pharmaceutist, &c. By EDWARD PARRISH. 2nd edition. Philadelphia: Blanchard and Lea. London: Morgan Brothers, 1859.

[Second Notice.]

THE second part of Mr. Parrish's book is devoted to what is rather affectedly called Galenical Pharmacy! As some of our readers may not understand what this may mean, we must explain that it relates to the mechanical operations which drugs undergo, to the processes of maceration, percolation, &c. to the preparation of tinctures, extracts, syrups, and conserves, and also to the distillation of waters and spirits. On all these matters the work affords full and satisfactory information, and we might particularly instance the the chapter "On the Powdering of Drugs and on Powders" as one which, while containing nothing but what a little experience would enable any pharmaceutist to make out for himself, is yet full of valuable hints for the beginner. For instance—how to get tartar emetic into a very fine powder suitable for preparing the ointment has puzzled many a dispenser who has rubbed the salt in a mortar until his arms ached; but Mr. Parrish tells us that by dissolving it in a small quantity of water, and then adding alcohol to the solution, the tartar emetic is thrown down in the form of an impalpable powder.

The chapter "On Extracts" is not so complete as we could have wished, for our author assumes "that their preparation is generally confined to those who make it their chief business," and he therefore thinks that a "few words in relation to their physical characters, and the mode of distinguishing those of good quality, will be more useful to a student than a description of the processes and precautions to be observed in making them." There is some reason in this, but we should have preferred a full account of the processes and precautions; and with regard to the modes given for distinguishing those of good quality, we are astonished that so experienced a pharmaceutist should have fallen into the mistake conveyed in the following quotation. "Extract of conium is one of the most difficult of the extracts to prepare and preserve. It should have a strong and characteristic odour, and is readily tested by the following experiment: Take a small pellet of the extract, soften it into a thin paste with water, and add a drop of solution of potassa, or of carbonate of potassa; immediately a strong characteristic odour will be observed, resembling, when faint, the odour of mice. This is from the liberation, in the gaseous form, of *conia*, the active principle of the herb; and on holding near it a rod dipped in muriatic acid, a cloud of ammonia will be produced." A few more experiments would have shown Mr. Parrish that the latter effect is produced when any extract of the same class is treated with potash, and a very little reflection would have shown him that this is due, not to the liberation of the active principle, but to the evolution of

some ammonia. The vapour of conia does indeed give white fumes with hydrochloric acid, but these consist of hydrochlorate of conia, and not of ammonia.

A little further on we find a process for the preparation of powdered compound extract of colocynth, which we believe to be superior to that generally employed in this country. It is recommended, in the first place, that simple extract of colocynth should be made with rectified spirit. This extract is evaporated to dryness, powdered, and then mixed with the aloes, scammony, cardamoms, and Castile soap, also reduced to powder. "This furnishes the preparation in powder in its most convenient and uniform condition, and about 7 per cent. of water is sufficient to form it into pill mass."

The fluid extract of dandelion we find Mr. Parrish recommends to be prepared from the root collected in September or October. As it is not always convenient to make a large quantity of the extract at once, the author quotes a process by Professor Proctor, which allows the preservation of the root in a fresh state, and the preparation of the fluid extract as it may be wanted. It is as follows:

"Take of fresh Dandelion root . . 20 pounds
„ Alcohol . . . . 4 pints.

Slice the roots transversely in short sections, and by means of a mill or mortar and pestle, reduce them to a pulpy mass; then add the alcohol and mix them thoroughly. The mixture thus far prepared at the season when the root is proper for collection may be set aside in suitable vessels, and extracted as the preparation is needed through the other seasons. After having stood a week, or until a convenient time, the pulpy mass is subjected to a powerful pressure, until as much as possible of the fluid is removed. This is then filtered and bottled for use. It is necessary that sufficient time should elapse after the pulp is set aside for the alcohol to penetrate the fibrous particles and commingle with the natural juices, as well as for the woody structure of the root to lose its elasticity, that it may yield the juice more completely on pressure. When the pulp has stood six months in this, it yields the juice with great readiness, and is possessed of the sensible properties of the dandelion in a marked degree. When eight pounds avoirdupois of the root are thus treated, after standing several months, the practical result is about six pints of fluid, with an ordinary screw press."

We pass over the remainder of the fluid extracts and also the syrups—of which latter, by the way, our American brethren have a wonderful variety, some of which, such as "the flavoured syrup of cream," we should very much like to taste—and come to the lozenges. Mr. Parrish considers these "a very eligible form of preparation for certain expectorant and other medicines, particularly for children," and he gives the following recipe of his own for the preparation of

"Phosphatic Lozenges.

Take of Phosphate of lime . . . 10 ounces
„ Phosphate of iron . . . 2 ounces
„ Phosphate of soda . . . 6 drams
„ Phosphate of potassa . . 2 drams
„ Sugar in powder . . . 17 ounces
„ Powdered ginger
„ Syrup of phosphoric acid, of each sufficient.

Mix the phosphate of lime and iron with the sugar and ginger by passing through a fine sieve; then by the aid of heat, dissolve the phosphates of soda and potassa in the syrup of phosphoric acid, and make into a mass with the mixed powders. Roll this into a cake of the proper thickness, dusting it with a sifted mixture of one part of phosphate of iron and eight parts of sugar, and cut out lozenges each weighing fifteen grains.

"The syrup of phosphoric acid is made by dissolving one drachm of the glacial acid in eight fluid ounces of syrup. Each lozenge will contain five grains of phosphate of lime, one grain of phosphate of iron, and half a grain of the mixed phosphates of soda and potassa."

These lozenges, we fear, will not be very agreeable to look at, but the taste will not be unpleasant, and children, we have no doubt, will be very ready to eat them. Another form for lozenges of the hypophosphites follows, but these evidently contain too little of the medicine to be of the smallest use.

Here for the present we must conclude, but we have still to notice two divisions of the book—those "On Pharmacy in its relations to Organic Chemistry," and "Inorganic Pharmaceutical Preparations," and to these we shall return on a future occasion.

CORRESPONDENCE.

The Constitution of the so-called Elementary Bodies.

To the Editor of the Chemical News.

Sir,—The grand principle upon which the whole of the science of chemistry is based is the doctrine of simple bodies. By it we are told that there are two distinct classes of matter; that cl. I. is composed of the 60 bodies that we cannot decompose, and that cl. II. comprises every other substance that we can decompose.

Now if you will allow me, I will endeavour to show that we cannot justify ourselves in regarding the members of cl. I. as elements, and that they cannot be separated from the bodies which usually go by the name of compound bodies.

With respect to the qualities of the substances belonging to both classes, it is impossible to draw a line of demarcation between them, inasmuch as when we begin to arrange them in groups, according to their properties, we invariably get members of both classes in the same group. Thus, when we compile a group that we call basyles, we get ammonium, NH_4, methyl, C_2H_3, &c. &c. among the metals. Again, when we make a group of radicals, we get cyanogen, C_2N, acetyl, $C_4H_3O_2$, &c. &c. among chlorine, iodine, &c.

Because we cannot decompose the 60 bodies of cl. I. are we to say that they will never be decomposed? It is easy to see that this is not just logic when we reflect that superior means of analysis and other circumstances may hereafter, as in times past, reveal to us the means of decomposing those very substances which we had so long treasured as elementary. It would be better logic to call all substances compounds, until we can prove them elements, than, as we actually do, to call all bodies simple until we can prove them compound. This method of procedure, induction and analogy require of us. By the terms simple and compound, we indicate two divisions of substances, the most diverse, with respect to their chemical constitution, that we can imagine. But on the other hand we have seen what a likeness exists between their chemical characters; and we know that substances having similar chemical properties are isomorphous in their chemical constitution; therefore it is but fair to infer that they ought not to be separated, but should be together under one head—that of compounds.

Glancing into organic chemistry, we notice the frequent occurrence of isomeric bodies. For instance, cyanate of ammonia, and urea are isomeric. Why have they different properties? Because they are not isomorphous, thus—one is NH_4O,C_2NO; the other, $C_2H_4N_2O_2$. No two bodies can be both isomeric and isomorphous without being portions of the same substance. How then are we to account the existence of allotropic states of the same so-called element? The only way of doing so is by saying that the so-called element is not a simple body, and by imagining the allotropic states in question to be isomeric.

In conclusion, if these 60 substances are not indeed elementary, it follows that two or more of them might chance to be isomeric and mutually convertible. Thus we see we are not quite so far from the realisation of the alchymist's hopes as some would lead us to imagine.—I am, &c.

13 Mark Lane. Thomas S. Barrett.

Arsenic in Hydrochloric Acid and its Compounds.

To the Editor of the CHEMICAL NEWS.

SIR,—My attention was called to the presence of arsenic in muriatic acid, many years ago, when I gave it as my opinion that pyrites, mundic or sulphur ore, containing arsenic had been used for the manufacture of sulphuric acid, which would thus contain arsenic, and that salt being decomposed by this acid, the arsenic would pass over with the muriatic or hydrochloric acid.

At that time I suggested as a remedy that the sulphurous acid should be cooled down sufficiently to allow the arsenic to condense before the sulphurous acid entered the chamber.

Various notices bearing upon this subject having lately appeared in the CHEMICAL NEWS, I am induced to repeat this suggestion:—That the sulphur ore should be roasted at a convenient distance from the chamber, but, to avoid a great length of flue, a series of small ascending and descending flues or chambers may be used, with some application for expediting the cooling of the vapours, and condensation of the arsenic,—the sulphurous vapour then to pass through a small fire brick oven, there to mingle with heated steam and hot nitrous acid gas, from a retort fixed near the oven; the mixed gases would then enter the chamber in the most favourable condition to form sulphuric acid.

One of our poets says:

"Where ignorance is bliss,
'Tis folly to be wise."

This is regarded as an English literary bull; if no evil consequences were to be apprehended, it might be as well to let the general public enjoy a blissful state of ignorance as to the various abominations which have been continually poured into their rivers; but with such a wholesale diffusion of arsenic continually going on in certain localities, who can say what articles may not show traces of that metal, how many innocent individuals may not be suspected or accused of administering that deadly poison to a near and dear relative.

I hope and trust that the CHEMICAL NEWS is destined to become the means of exposing such monstrous abuses, more especially as it will offer to some of the best-informed members of the community, a medium through which they may express their opinions and suggest remedies.

Apropos to the application of the perchloride of iron containing arsenic to the sewers of London, a plea may be put forth, that it will be a good mode of destroying the swarms of rats that infest London, but a weighty consideration must be urged as an objection to this plan, that the putrifying remains of these animals might become a frightful nuisance, and the source of a fatal malady.—I am, &c.

AN OLD ALKALI MANUFACTURER.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTY.

Solubility of some Salts of Lime in Ammoniacal Solutions.—M. Ch. Mène[1] points out some important facts in the history of the lime salts which have been hitherto overlooked. If, he says, we take a solution of chloride of calcium and add to it a solution of carbonate of soda or potash, a voluminous white precipitate is thrown down: if now we add a solution of sal-ammoniac the precipitate is immediately redissolved, and if the sal-ammoniac be added before the carbonate, no precipitate at all is formed. When the solution is boiled, the precipitate in the first case is not reproduced, but some ammonia is given off. The sulphate and phosphate of lime are dissolved under the same circumstances. The experiment succeeds just as well with the sulphate and nitrate of ammonia as with the hydrochlorate, but the carbonates and phosphate of ammonia will not dissolve the lime precipitate. The carbonates of soda and potash will dissolve carbonate of lime, while the bicarbonates do not. If common chalk and a piece of sal-ammonia be placed in distilled water for only a few moments and the liquid be filtered, the filtrate gives an abundant precipitate with oxalate of ammonia. A bone digested for some hours with a strong solution of sal-ammoniac becomes as soft as it would be if placed in a solution of carbonic acid gas or another acid.

These results show that only the oxalate of ammonia can be used to detect and estimate the salts of lime; and that in the case of natural waters which do not contain free carbonic acid, but may contain ammoniacal salts (and the analyses of Boussingault, Bineau, Henri and others show that nearly all waters do contain ammonia or salts of ammonia), the presence of a large amount of carbonate or other salts of lime must be ascribed to the presence of the ammoniacal salt and not to the carbonic acid forming an alkaline bicarbonate, since the bicarbonates do not dissolve carbonate of lime. Further, when a large quantity of lime salts is found in a water, ammoniacal salts ought always to be looked for, since these facilitate the solution of the lime.

As nearly all natural waters contain ammoniacal salts, the author supposes that stalactites and other calcareous deposits may be formed by the evaporation of the water of solution. What seems to prove this is that waters do not in general contain free carbonic acid, and that the air of stalactite grottoes does not contain more carbonic acid than the air of other places. He also supposes that vegetables derive their lime from a solution in the ammoniacal salts of the manures, &c.

Action of Sulphuric Acid on Peroxide of Hydrogen.—M. Riche[2] has tried the action of monohydrated sulphuric acid on a solution of the peroxide of hydrogen of the maximum strength. Dilute sulphuric acid, we know, assists in keeping the peroxide: but when the latter is added to the monohydrated acid, oxygen is disengaged, all of which however, is not in the ordinary condition, for it possesses the odour of ozone, and blues the iodurette starch paper. When acted on by caustic potash the peroxide of hydrogen gives off oxygen, the whole of which is in the ordinary condition.

The fact mentioned above is opposed to the theoretical views of Schönbein, who considers the oxygen in the peroxide to be in the Θ condition; it ought not therefore, to give off ozone Θ when acted on by the sulphuric acid.

II. ORGANIC CHEMISTRY.

Contributions to the History of Putrefaction.—Karsten has studied[3] the action of atmospheric air and oxygen on various non-azotised organic compounds, by, in some cases, passing a current of dry air slowly over them, and, in others, by leaving them for a long time over mercury in a graduated tube filled with air or oxygen. He found that starch, gum arabic, wax, sugar, and resin, under these circumstances always produced carbonic acid, starch furnishing the least, and resin the most. Water was produced at the same time, but no constant relation could be established between the water and carbonic acid. The action goes on at a temperature below zero, and in the dark. When the ordinary air is *ozonised* the action is much more energetic, and nearly four times as much carbonic acid is produced as with common air. A most interesting fact observed was that carbon itself is slowly consumed in cold air, and furnishes carbonic acid.

Chinovic Acid.—M. de Vrij has repeated[4] the experiments of Hlasiwetz on the chinovic acid of Pelletier and Caventon (CHEMICAL NEWS vol. i. p. 19), and also comes to the conclusion that the reputed acid is really a glucoside, which can be separated into an acid and a species of sugar. He proves besides that the glucoside is always accompanied by a bitter principle which is not soluble in alcohol and chloroform, and which, it seems, is the same crystalline acid obtained from the glucoside. The author proposes to call

[1] *Comptes-Rendus*, t. li. p. 180.

[2] *Répert. de Chim. pure*, liv. vii. p. 178.

[3] *Poggend. Ann. der Phys. u. Chem.* Bd. cix. s. 346.

[4] *Journ. de Pharm. et de Chim.* t. xxxvii. p. 255.

the glucoside *cinchona bitter*, and to give the name *chinovic acid* to the acid. The substance has been tried with some success in the hospitals of Batavia, and as it is advisable to utilise, if possible, all the cinchona products, it might be worth while to give it a trial here. The following is the method of procuring the glucoside:—Ground cinchona bark is macerated in a cold dilute solution of soda or potash, and the alkaline liquor is precipitated by an acid. The voluminous precipitate which falls is redissolved in milk of lime, and the solution, filtered and boiling, is treated with hydrochloric acid. The precipitate thus produced is washed, pressed, dried between porous stones and powdered. So prepared cinchona bitter is entirely soluble in lime water, and the best way of administering it is in combination with lime or magnesia with both of which it forms soluble compounds.

Composition of Cocoa.—Tuchen has analysed various specimens of cocoa to determine the amount of theobromine they contained. His results are as under[1]:—

	Fatty matter.	Theobromine.	Ash.
Guayaquil . .	36·38	0·63	3·03
Surinam . .	36·97	0·56	3·00
Caraccas . .	35·08	0·55	2·92
Para . . .	34·48	0·67	3·09
Maragnow . .	38·25	0·38	2·92
Trinidad . .	36·42	0·48	2·98

III. ANALYTICAL CHEMISTRY.

Detection of Nitrates in very dilute Solutions. M. F. Bucherer gives a process which he states will detect $\frac{1}{100000}$th of a nitrate in aqueous solution. It is founded on the action of nitrous vapours on iodide of potassium; the potassium is oxidised by the oxygen of the nitrous vapours, which are thereby reduced to the state of binoxide, and iodine is set at liberty. For the test to be conclusive, any chlorine or bromine must have been separated from the liquid. The author places 2 or 3 drams of the liquor to be tested in a tube 6 or 8 inches long, introduces a few copper turnings, and but 3 or 4 drops of strong sulphuric acid. He then boils for a moment and nearly fills up the tube with water; he now adds a few drops of a solution of iodide of potassium. If the liquor contains any nitrate the iodine is set at liberty, and on adding a small quantity of sulphide of carbon and shaking vigorously the sulphide will dissolve the iodine, and float on the surface of the liquid, taking a violet or deep red colour, according to the quantity of iodine displaced.

To detect free nitric acid the author operates as above, but omits the sulphuric acid. To detect a nitrite, he uses the same method with the omission of the copper.

MISCELLANEOUS.

The late Trial for Poisoning at Lewes.—In the House of Lords on Tuesday last the Earl of Harrington gave notice that on Monday next he should move for a report of the proceedings at the coroner's inquest on Mrs. Bull, who was said to have been poisoned by the administration of an overdose of prussic acid by her son, George Bull, while he was in a state of intoxication.

Female Pharmaceutists.—Mrs. Mary Fajarde and Mrs. Caroline de Matos, have lately obtained diplomas as pharmaceutists from the Medico-Chirurgical School of Lisbon. It would appear that these ladies had already been admitted in the same capacity at Oporto, in 1829.

The Act for preventing the Adulteration of Food or Drink received the Royal assent on Monday evening. In our next number we shall give an analysis of its provisions.

Rough Plate Glass, not transparent, but well adapted for railway-stations and workshops, and for use in horticulture, is now made by a very simple means, patented by Mr. Hartley of Sunderland. The sole secret consists in ladling rough glass directly on to a hot table near the melting-pot, in place of carrying it as heretofore out of the refining-pot to a cold table at some distance from the furnace. By this means rough plate-glass is now made in minutes instead of hours or days; and in patterns stamped by the table, which becomes so hot as to keep the glass molten till stamped, and till one ladleful is added to another and imperceptibly joined to it, so as to form plates of any size. One glass-making firm is stated to have expended 25,000*l.* in vainly endeavouring to use the ladle and to draw the table close to the rough melting-pot!—*From Timbs's Curiosities of Science, Second Series, just published.*

French v. English Iron.—A witness examined before the Council of commerce with regard to the fixing of the iron duties under Mr. Cobden's treaty declared that the English cannot make iron for the sheathing of a ship of war of such good quality as the French. This witness was M. Emile Martin, formealy of the Fourchambault works; and what he said was:—"In order to cover a frigate with iron it is not England which can supply the proper material; it is France—no one will contradict me on that point!" (Pour blinder une frégate, ce n'est pas l'Angleterre qui peut fournir, le fer convenable à cet usage, c'est au contraire la France: personne ne me démentira là dessus.)—*Engineer.*

International Congress of Chemists.—The *Augsburg Gazette* states that the international congress of chemists, which was to have been held last spring, is definitely fixed to meet at Carlsruhe on the 3rd of September. Letters of invitation have been addressed to all eminent chemists, and especially to professors of chemistry in public schools and colleges.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

T. G. Wormley, M.D. Columbus, Ohio.—The enclosure has been received with thanks. It will appear in an early number. We shall always have much pleasure in receiving similar articles from our valued correspondent

S. K. E.—Probably Dr. Normandy's work on Adulterations would answer your purpose as well as any. It contains directions for the examination of waters.

A Sub.—1. The prepared oil is to be had, we believe, at tool sellers'—Fenn's, in Newgate St., for instance. 2. No; and they would be inapplicable to fine machinery.

Mem. Brit. Ass.—The conclusion will appear in our next.

Dr. Valentin has our best thanks.

A Subscriber is thanked.

Received—*H. N. Draper—B. D.—A Subscriber—Ignotus.*

☞ Reading covers have been prepared for preserving the numbers of the CHEMICAL NEWS until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

Vol. I. of the CHEMICAL NEWS, containing a copious index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

*** All *Editorial Communications* are to be addressed to Mr. CROOKES, and *Advertisements* and *Business* communications to the PUBLISHERS, C. MITCHELL & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E. C.

CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnandon in Italy; Muños de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, BAILLIÈRE, 219 Regent Street, London.

[1] *Chim. Technol. par R. Wagner*, Bd. iv. p. 432.

THE CHEMICAL NEWS.

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THE SALE OF POISONS.

We publish two communications to day — one from an eminent drug firm, the other from a well known practical philanthropist—for which we ask the serious attention of our pharmaceutical readers. They show at once what is passing in the minds of the thinking part of the public on the subject of the sale of poisons, and also the preventive measure which one of our largest dispensing firms proposes, to avoid the possibility of accidents or mistakes. Of the latter we can only say that it appears to us almost perfect. The idea on which it is based is original and ingenious. The classification of poisons, or rather the definition of what ought to be considered a poison, has always been a difficult matter; and the difficulty, so far as medicines are concerned, has rather been to say what was not, than what was, a poison. Now by making the maximum dose the test, the difficulty is at once solved; and by keeping all the more active medicines in such vessels as shall immediately indicate their dangerous nature, all possibility of accidentally substituting a poisonous for a harmless remedy is completely precluded. Under such circumstances it could never happen that tincture of opium should be sold for tincture of rhubarb, nor liquor opii sedativus be given for black draught, nor strychnia be dispensed for quinine.

It is of course quite unimportant what plan may be adopted, but some system of the sort we believe is imperatively called for. It is open to any other druggist to propose a better, and we have no doubt Mr. Savory only says with Horace—

> "Si quid novisti rectius istis
> Candidus imperti; si non, his utere mecum."

Of our other correspondent's letter we need not say much. Our readers know that we advocate "free trade in physic," and therefore in poisons. We believe this to be in the end the safest for the public, and are convinced that any legislative interference with the trade would only defeat its own object. But we would go quite as far as our correspondent in making every person responsible for the consequences of his acts; and if a druggist should sell a quarter of a pound of arsenic to relieve a toothache, and that arsenic should afterwards be used for the purpose of murdering an individual, we could not altogether acquit the druggist of some moral complicity in the murderous deed.

It is absurd, however, to suppose that a druggist ever sells a poison with the idea of its being used for either murder or suicide. He knows full well that a man who would be killed by a pennyworth of arsenic or oxalic acid may live to buy many doses of much more profitable medicines. But indeed we estimate our brethren far too highly to suppose for a moment they would be actuated by such a purely selfish motive as this; and if our correspondent knew how often an obviously miserable wretch is gently denied, and a suspiciously confident individual is flatly refused a poison, her only wonder would be that suicide and murder by such means are not much more common occurrences.

ARSENIC IN THE RIVER.

"Who shall decide when doctors disagree?" is a question often asked and seldom replied to. We certainly would not presume to arbitrate in the very pretty quarrel now going on between Drs. Hofmann and Frankland and Dr. Letheby. All that we can do is to point out that a difference of upwards of fifty grains of arsenic in a gallon of liquor is rather beyond the limits of allowable error in determination; and that if the samples of the perchloride of iron were really taken from the same bulk, one or the other's method of analysis must be very defective.

On the larger question, however, whether it be advisable or not to pour all this arsenic into the river we have not so much hesitation. Mere chemists are apt to presume too much on the strength of the insolubility of a substance in distilled water. We remember one intrepid gentleman who, presuming on that fact in the case of sulphite of lead, publicly offered to administer any amount of the salt to his own children. Some other gentleman, however, first of all tried the experiment on dogs, and found that it poisoned them, and thereby prevented the possible sacrifice of some innocent offspring.

We should be very sorry ourselves to swallow much of this "insoluble compound of white arsenic with peroxide of iron," although it might be, as Drs. Hofmann and Frankland assert, perfectly innocuous. But it is not for this reason that we object to the use of the chloride of arsenic. We believe it to be advisable to restrict the presence of arsenic as much as is possible. We have reached a very dangerous point of knowledge when we have proved the presence of this poison almost everywhere. Henceforward it will be impossible to hang a man because a minute quantity of arsenic was found in the excretions of a friend or relative who may have died with symptoms for which medical men may have found it hard to account, and slow poisoning by very small doses may be greatly increased in consequence.

What the popular feeling on the matter is, is shown by the verdict in a trial at Chester, which we report to-day.

When "the ultimate plan of dealing with sewage contemplated by the Metropolitan Board," is carried out, we may no doubt safely make use of perchloride of iron containing arsenic; but until then it will be best to rely on other deodorisers which are just as cheap, quite as effective, and without a suspicion of danger.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Numerical Relations existing between the Equivalent Numbers of Elementary Bodies, by M. Carey Lea.[1]

The first part of this paper (Chemical News, vol. i. p. 169) was devoted to the examination of relations between the equivalent numbers of certain elementary bodies depending upon the number 44—45, and it was attempted to show: —

1st. That such relations extend to nearly all the elements:—

2nd. That the particular groups collected together by this relation consist of bodies whose properties are analogous, and that the classification is in harmony with the distinguishing characteristics of the substances classified.

The first portion of this second part will present a species of relation wholly distinct, it is believed, from any that has hitherto been pointed out, and which may not be inappropriately termed Geometrical Ratios. The nature of these relations consists in this, that if we take two substances and examine the ratio which subsists between the numbers representing their atomic weights, we may find in certain cases that it is identical with the ratio subsisting between the atomic weights of two other substances, and so on through a considerable number of elements. The ratio between the atomic weights, for instance, of oxygen and nitrogen, is that of four to seven, so likewise is that between those of zirconium and potassium, potassium and barium, with absolute exactitude. What renders this the more remarkable is, that all three of these last substances are striking exceptions to Prout's law that the equivalents of the elements are exact multiples of that of hydrogen; they all have decimals Zr 22·4, K 39·2, Ba 68·6. Now the ratio just mentioned gives these numbers, with their decimals, with perfect exactness. In many other cases it will be found that four-sevenths of the atomic weight of one body will give a close approximation to the atomic weight of another body.

We append a few examples from a table of the oxygen-nitrogen ratios given by the author:—

N	=14	4/7 of 14	=8	O	=8
Ba	=68·6	4/7 „ 68·6	=39·2	K	=39·2
K	=39·2	4/7 „ 39·2	=22·4	Zr	=22·4
Sr	=43·75	4/7 „ 43·75	=25	Ti	=25·0
Pb	=103·5	4/7 „ 103·5	=59·16	Sn	=59.
Bi	=208	4/7 „ 208	=118·84	Sb	=120·3
Cl	=35·5	4/7 „ 35·5	=20·28	Si	=21
F	=19	4/7 „ 19	=10·86	B	=10·9
B	=10·9	4/7 „ 10·9	=6·23	C	=6

The last three equations in the table show us that the atomic weight of silicon stands nearly in the same numerical relation to that of boron as that of chlorine does to fluorine, and that both these ratios approach nearly to that existing between the atomic weight of boron and carbon. Now as the atomic weight of boron is by no means positively determined, it may be allowable to examine how far an hypothetical number will fulfil these several ratios. Let us assume:—Fl : Cl : : C : B. We find:—

$$\frac{\text{Chlorine } 35{\cdot}5 \times \text{Carbon } 6}{\text{Fluorine } 19} = 11{\cdot}2104$$

and obtain for the hypothetical equivalent of boron 11·21. Let us now examine how far the number 11·21 will fulfil the second proposed ratio, viz.—C : B : : B : Si.—

$$\frac{(\text{Boron } 11{\cdot}21)^2}{\text{Carbon } 6} = 20{\cdot}944$$

a close approximation to 21, the received number.

Again: the atomic weight of carbon stands to that of nitrogen in the ratio of three to seven, a relation which is found exactly or approximately to extend to certain other elements.

N	= 14	3/7 of 14=6	C	= 6	
Fe	= 28	3/7 „ 28=12	Mg	= 12	
P	= 31	3/7 „ 31=13·29	N	= 14	
Br	= 80	3/7 „ 80=34·29	Cl	= 35·5	

The proportions expressed by the preceding tables may be differently expressed, and perhaps rendered more striking. As the numbers which express the equivalent weights of the elements are altogether relative, it is of course a mere question of convenience which is selected as unity. If in place of adopting the equivalent of one substance, as that of hydrogen or oxygen, as a permanent unit, we successively make those of the substances contained in the right hand column of the first table our unit, and consider the effects of such a change upon the equivalents of the substances contained in the left hand column, we shall obtain the following results. Making the equivalent of—

O	100	the equiv. of		N	becomes	175
K	100	„	„	„	Ba	„	175
Zr	100	„	„	„	K	„	175
Ti	100	„	„	„	Sr	„	175
B	100	„	„	„	Fl	„	174·3
&c.					&c.		

The same view may be extended to the seconds table. Making the equivalent of N 100, that of carbon becomes 42·8: if fluorine be 100, O becomes 42·1; if iron be made 100, magnesium becomes 42·8, and so on. It is therefore clear that the atomic weight of each substance in the left hand column of these two tables bears to that of the corresponding substance in the right hand column a definite numerical ratio, which is identical, or nearly so, with that borne by the atomic weight of any other substance in the same column of the same table to that of the corresponding substance in the other column.

We have seen that many elements stand to other elements in the same relation as nitrogen to oxygen, many in the same relation as nitrogen to carbon. Apart from these more general ratios, many elements may be classed together in double or treble pairs, such that the two elements in one pair stand to each other in the same numerical ratio as the two elements of a second or third pair, the two elements constituting each pair being more or less closely allied to each other in properties, though the pairs are not necessarily analogous with those with which they are compared.

For instance, arsenic stands to antimony in the same numerical ratio as selenium to tellurium, within an ex-

[1] Abridged from *American Journal of Science and Arts*, May 1860.

tremely small fraction, so that by multiplying and dividing we have:—

$$\text{Ar. } 75 \times \frac{\text{Te } 64}{\text{Se } 64} = 120 \quad \text{Sb} = 120{\cdot}3$$

So, in like manner, magnesium stands to zirconium in the same ratio as fluorine to chlorine; carbon stands to boron in the same ratio as silver to gold; and phosphorus to nitrogen in the same ratio as strontium to calcium.

(To be continued.)

TECHNICAL CHEMISTRY.

Arsenic in a Water Supply.

At the Chester assizes, before Mr. Baron Bramwell, an action was brought by the Stockport Waterworks Company against Messrs. Henry Turner, Thomas Norris, and John Turner, the owners and occupiers of print-works on a stream which is one of the tributaries of the Mersey, for damage resulting from the pollution of the stream by the discharge into it of poisonous fluids from defendants' works.—Mr. Collier, Q.C. Mr. Coxon, and Mr. Macintyre, were for the plaintiffs; and Mr. Welsby, Q.C. Mr. Grove, Q.C. and Mr. H. Lloyd, for the defendents.

From Mr. Collier's statement of the case, it appears that Stockport has been supplied with water from the Mersey since 1825, at which time it was a comparatively pure stream, and was remarkably good for trout and salmon fishing. In process of time, however, numerous print and other works have been erected on the banks, and the water has become more and more contaminated and discolored. In 1858 the the directors of the Waterworks Company consulted Professor Calvert of Manchester, who came and took samples in order to analyse them. Samples of mud and water were both taken out of the river, and on examination were found to contain arsenic in considerable quantities. The directors also got some of the mud from their reservoirs above the Stockport Waterworks, and had it analysed, and it also contained arsenic. For some time, however, there was no arsenic found in the water supplied to the customers, as it had taken a solid form in the reservoirs; but they had serious misgivings as to dispensing water amongst their customers which might, any day, contain a considerable quantity of arsenic if, by any chance, sulphuric acid should come in. Under all the circumstances the directors thought it necessary to get the best possible scientific knowledge on the subject, and accordingly Professor Playfair of Edinburgh was applied to, and he, after examining some of the samples of mud and water, found arsenic. Samples of water were taken from the top of the George Inn, Stockport, as supplied from these waterworks. One or two samples were taken and analysed by Professor Playfair and Dr. Miller of London, and these gentlemen found arsenic in it, as well as in samples of the mud taken from the river. There had been no sickness or symptoms of poisoning exhibited in the town, but the directors thought it better to bring their action before than after such a thing had occurred.

Professor Calvert stated that on analysation he found 4·17 grains of arsenic in a pound of mud taken from the Waterworks Company's reservoir. He also found arsenic in the mud opposite Messrs. Turner's works. There had been a great change made in the process used in calico printing works during the last few years; arsenic had come into use in great quantities, which increased the deleterious character of the refuse. A very little additional outlay would render the present process innocuous.

Professor Miller of King's College, London, and Dr. Lyon Playfair of the Edinburgh University, stated that they had discovered arsenic in water obtained from the George Inn, Stockport, which was supplied by the Waterworks Company. The quantity was small. Professor Miller also found in the water carbonate of lime, carbonate of magnesia, and oxide of iron, which were all precipitants of arsenic.

Mr. Grove opened the case for the defence. It has been found that ten grains of solid matter issued from the defendants' works, and this was only four grains in excess of the normal condition of the water. Could it be pretended that this inappreciable amount could contaminate the Stockport Waterworks at a distance of thirteen miles? Between the defendant's works and the waterworks there were no less than 103 other works of various descriptions, in which arsenic and all sorts of similar ingredients were used. He contended that no proof had been adduced that the contamination of which the plaintiffs complained was the result of what issued from the defendants' works, and it was for them to satisfy the jury of this fact before they could establish their case. He ridiculed the notion that arsenic found to the extent of four-sixths of a grain could be said to exist to a dangerous extent when it was well known that it existed in almost every kind of water; and when, by the presence of carbonate of lime in the river, any arsenic that might exist must be rendered perfectly innocuous.

Mr. Alfred George Fisher, architect and surveyor, Manchester, said that on the river from the various sources to Nadd's Poole from which the plaintiffs took their supply, there were twelve printworks, four baryta works, ten coal pits being worked, three chemical works, two dyeing and bleaching works, four paper mills, one crape dyeing works, sixty-one cotton mills, iron foundries, and machine shops; there were gas works at nearly every establishment, and one public gas work; total number of works, 104. He knew the sewerage passed into the river. In the villages adjoining the river the population was upwards of 58,000 at the last census; and that number had since been very largely increased. The sewerage of the villages in every instance fell into the rivers.

John M'Connell said he had been for thirty years engaged in the printing business, and for two years had been manager for the defendants. When he first went to them, they used some little arsenic as a mordaunt. The arsenic was absorbed in the process. At present very little deleterious matter was used in the defendants' works. An alarm was raised about their using arsenic, and now they did not use the arseniate of soda in the dunging liquor, but phosphate of soda. In his judgment, nothing issued from their works that could produce injury at Stockport.—Cross-examined: They used a small portion of white arsenic; but he could not say that from the 11th of May to the 3rd of August 1859 there were 3¾ cwt. of white arsenic used. Vitriol is used in the works, but I will not say that 17,000 lbs. were used from the 11th of May to the 3rd of August. Sugar of lead is also used.

Mr. Dugald Campbell, consulting and analytical chemist, said that he found in the year 1855 he found the water of the river Goyte yellow, and had a ropy sort of sediment. He had examined the pyrites and the sand found in the river, and in the pyrites he found a marked and decided quantity of arsenic; and in one-eighth of an ounce of sand he also discovered arsenic. He had

calculated that 1 lb. of the sand would produce half a grain of arsenic. The arsenic in the mud was insoluble. He also found antimony in the sand. The colouring matter used in the works has a great affinity for lime, and certainly would not reach thirteen miles. Notwithstanding the intermediate works and the acids said to be thrown into the river, he did not find any appreciable colouring matter in the water at the waterworks. He thought that any portion of colouring or organic matter which might escape the defendants' works would be precipitated before it got thirteen miles, by coming in contact with the lime, magnesia, and ammonia naturally in water.

Mr. Daniel Stone, professor of chemistry at the Royal Manchester School of Medicine, had been engaged by the defendants to ascertain whether any arsenic was to be found in the water or the mud near the works, and, if found, to devise a remedy. By his recommendation phosphate of soda was substituted for arsenic in the process of the manufacture. A large filter bed was also made, into which to return the refuse water of the dunging liquor. He had seen the filter beds at work, and they were sufficient to prevent, except to an inappreciable extent, the escape of any arsenical compound. At the Stockport Infirmary he found no traces of arsenic in the water. The baryta works which had been mentioned were the works for the manufacture of chemicals, which were extensively used in adulteration.—Cross-examined: I was employed by the defendants first in 1858. I have heard that there is a combination of calico printers to protect themselves against such actions as these.

Dr. Taylor, professor of chemistry at Guy's Hospital, said that carbonate of lime was to his knowledge used as an antidote for arsenic. Arsenic existed in rivers which passed over ferruginous districts. He was of opinion that the colouring matter spoken of as issuing from the defendants' works would be destroyed by being mixed with lime, and by being oxidised through exposure to the light. Speaking *à priori*, he should say that where ten grains of solid matter had to travel thirteen miles it could produce no appreciable effect.

Mr. E. H. Pitman, Mr. George Graham, and Mr. A. H. Shaw, medical gentlemen connected with Stockport, spoke of the general healthiness of the place.

Mr. Collier having replied at some length, the learned judge submitted to the jury the following questions:—1. Assuming that the water was in a natural state except for what the defendants had done, would what they had done sensibly deteriorate it? 2. Assuming as before, and supposing there is no actual sensible deterioration caused by the defendants, would what they have done, if continued, sensibly deteriorate it? 3. Have the defendants sensibly deteriorated it as it stands—that is, taking into account its other pollutions? 4. If they had continued, would they have done so? 5. Has any actual loss accrued to the plaintiffs? 6. Is there any defence to this action upon the authority of the case *Hole* v. *Barlow*.

The jury decided the first four questions in the affirmative, and the fifth and sixth in the negative.

On the Empoisonment of the Thames with Arsenical Perchloride of Iron, by Dr. Letheby.

[The following letter has been addressed to the Chairman and Members of the Metropolitan Board of Works, in reply to the report of Dr. Hofmann and Dr. Frankland, which we gave in the last number of the Chemical News, page 100.]

Gentlemen,—I have just received a printed copy of a report by Dr. Hofmann and Dr. Frankland, on a communication from me with reference to the quantity of arsenic in perchloride of iron; and as the report reflects in some degree on my skill and judgment in the matter, and is, moreover, calculated to diminish the importance of the subject by diverting your minds from the main facts of the question, I beg leave to reply to it.

And here, at the outset, I may remark, that although the reporters have verified, in the most conclusive manner, the principal fact to which I directed your attention, namely—that the perchloride of iron which you were about to use for the deodorisation of London sewage is charged with a poisonous compound of arsenic, yet their admission of it is accompanied with so many dangerous fallacies that I am bound to notice them. If it were not for this I should have left the fact in all its plainness for your consideration, being confident that you would have disposed of it in the manner best suited for the public interest.

In the first place, the reporters say, as if it were a matter of but little importance, that "the perchloride of iron, manufactured for disinfecting purposes, almost invariably contains a small quantity of arsenic, which is derived from the iron ores used in its preparation." But I must tell you this is not the only source of the poison, for it comes in far larger proportion from the crude muriatic acid employed as the solvent. Years ago, when Mr. Ellerman first proposed the pyrolignate of iron as a disinfectant, the presence of arsenic in it, from the oxide employed, was considered a serious objection to its use, and now there is an additional danger from the large quantity of arsenic contained in the solvent. What may be the usual amount of arsenic in the perchloride is apparently open to doubt; for the reporters have found only half the proportion discovered by me. I will not pretend to reconcile this discrepancy; but I may be allowed to state that the recognition of arsenic in all its poisonous forms has been with me a subject of especial study; and the proportions mentioned in my report are the mean of three nearly concordant results; and that the sample which I have examined was supplied to me by Mr. Dales "as the same as that reported upon by Drs. Hofmann, Frankland, and Miller."

As to the importance of the fact that arsenic is a constituent of the perchloride, the reporters are of opinion that it need not afford grounds for the slightest apprehension of danger; for they say, "it is well known that the most efficient antidote of arsenic is the hydrated peroxide of iron, such as is produced by the addition of alkaline liquids to perchloride of iron. The action of this antidote depends upon the formation of a compound of white arsenic with peroxide of iron, which is perfectly insoluble in water, and consequently absolutely innocuous." If the reporters had been acquainted with the medical literature of the subject, or had been so circumstanced as to have had any practical knowledge of the *modus operandi* of the peroxide, they would not have spoken so positively of its antidotal powers, or have committed themselves to so erroneous an opinion. More than twenty years ago, Orfila, after careful inquiry, demonstrated that the hydrated peroxide of iron was not a protection to the poisonous effects of arsenic; for although it forms a compound which is insoluble in water, it is not insoluble in the acid secretions of the stomach. Modern experience has confirmed this view of its action, by showing that peroxide of iron is not an antidote to

to arsenic, unless it is used in sufficiently large quantity to cover or, as it were, to plaster the walls of the stomach, and so to prevent absorption. Even then it is a worthless antidote when the poison is in a solid form; for, to use the words of the last writer on this subject, Dr. Taylor, "it has no more effect on solid arsenic than so much powdered brick-dust, and to rest upon it as a neutraliser of the poisonous action of solid arsenic would be a delusion."

Again, if the reporters had studied a little more deeply the therapeutics of our chalybeate springs, they would have attached no importance, as far as the present case is concerned, to the fact that "modern chemistry has proved the existence of arsenic in the ferruginous deposits from the majority of mineral waters;" for those waters are never used for domestic purposes. On the contrary, they are so highly charged with medicinal substances as to be used only for medical purposes. It is not correct therefore to say that the Wiesbaden water, which contains one grain of arsenic in 166 gallons, is generally regarded as a wholesome water; nor would the reporters, with all their apparent confidence in the antidotal powers of dilution, be rash enough to tell you that such a water is fit for common or domestic uses.

Above all it is not an unimportant fact, that if perchloride of iron were used for the disinfection of sewage, as much as one part of arsenic would exist in 3000 of the sediment; for all who are acquainted with the criminal jurisprudence of modern times are aware how serious a matter it is to have arsenic in anything which may, by accident or otherwise, be brought into contact with the human body. Over and over again the presence of this poison, not in the proportion of one part in 3000, but of less that one part in 140,000 of the soil of a grave-yard has embarrassed the labours of the chemist, and obstructed the progress of justice. Many a criminal accused of having murdered with arsenic, has found a successful defence in the fact that the soil in which the dead body has laid may have been charged with arsenic, and may have furnished the poison found in the corpse. Who, therefore, would rashly complicate such an inquiry by adding arsenic to the soil in which a poisoned body may be found? Or why, as in the present instance, should you resort to a disinfectant which is not only useless and expensive in its application, but so dangerous in its results; for where, let me ask, would be the chance of a conviction if, after the saturation of the soil of the Thames with arsenic, a cunning poisoner were to get his victim stranded upon the shore of the river? I beg of you to consider that it is no light matter to resort to a process of disinfection which might not only be dangerous on its own account, but by impeding the course of justice might also favour the commission of crime.

Lastly: I may remark that the statements made by the reporters concerning the dilution of the arsenic with the water of the river is not altogether in accordance with facts. They say that the average volume of water which passes Richmond daily is calculated at 800,000,000 of gallons, and that with other supplies the quantity of water for diluting the arsenic is not less than a thousand millions of gallons daily. But this is the daily average for the whole year: it is not the quantity which flows into the Thames during the hot days of summer when the deodoriser would be in use. At that time there is no such dilution of the poison at the points where you would cast it into the stream, for the downward flow of fresh water is barely sufficient to provide for evaporation, and little or nothing goes to the sea. On the contrary, there is an upward flow of the current, and the water of the Thames becomes largely impregnated with sea salt. Then it is that your deodoriser would be used in the largest proportion; and day by day it would be poured into the same body of water, and would oscillate between the ranges of the tide, making it more and more poisonous, until the danger might be beyond a remedy.

Apart, however, from all these considerations, may I venture to ask you what would be your opinion, and what the opinion of the public, if a manufacturer on the banks of the Thames were to cast daily into the river a quantity of refuse containing as much as a hundred weight and a half of arsenic? Do you think that if a legal prosecution were instituted against him, as most assuredly it would be, the law would be satisfied, or you or the public contented, with the sophistical defence which your reporters have furnished to you? Would it be enough to say that the oxide of iron in the river was the antidote of the poison—that there were mineral springs in Europe with larger proportions of arsenic than the river contains, and that the water of the Thames had diluted it to an enormous degree? I know what your answer would be to such a case, despite the most skilful arguments, and knowing it, I beg of you to consider that by adopting the use of this arsenical perchloride of iron, you would be doing that which the manufacturer is supposed to have done, and would be the means of casting into the Thames as much as a hundred weight and a half of arsenic daily. I can scarcely venture to think that any kind of confidence in the arguments of your reporters would justify you in adopting such a course, or would excuse you for the mischief that most assuredly would come of it.—I am, &c.

H. Letheby.

41 Finsbury Square.

The Act for Preventing the Adulteration of Articles of Food or Drink.

The preamble of the above Act recites that: Whereas the practice of adulterating articles of food and drink for sale, in fraud of Her Majesty's subjects and to the great hurt of their health, requires to be repressed by more effectual laws than those which are now in force for that purpose: Be it therefore enacted, &c.

The Act contains fourteen clauses, from which we extract those which will be of interest to our readers.

Clause 1. Every person who shall sell any article of food or drink with which, to the knowledge of such person, any ingredient or material injurious to the health of persons eating or drinking such article has been mixed, and every person who shall sell as pure or unadulterated any article of food or drink which is adulterated or not pure, shall for every such offence, on summary conviction, pay a penalty not exceeding five pounds, and such costs as the justices shall seem reasonable; and on a second conviction the justices may cause the offender's name, address, and offence to be published, at his own expense, in such newspaper or in such manner as the justices may deem desirable.

Clause 2 is a very important one, and we quote it at length.

"On the hearing by the justices of any complaint under this Act in any district, county, or borough wherein any analyst shall have been appointed, the purchaser shall prove to the satisfaction of such justices, that the seller of the article of food or drink alleged to be adulterated or his servants had such notice of the intention of the purchaser to have such article analysed, and also such

opportunity of accompanying the purchaser to an analyst appointed by this Act, as the justices shall think reasonable, in order to secure such article from being tampered with by the purchaser."

Clause 3 relates to the appointment of the analysts. In the City of London the Commissioners of Sewers, in other parts of the metropolis the Vestries and District Boards; in England and Ireland the Court of Quarter Sessions of every county, and the Town Council of every Borough having a separate court of quarter sessions, and in Scotland the Commissioners of Supply for counties and Town Councils within their jurisdictions, these *may* for their respective districts appoint and remove one or more persons possessing competent medical, chemical, and microscopical knowledge as analysts, and may pay to such analysts such salary or allowances as they may think fit, the appointment and removal to be approved by a Secretary of State in Great Britain, and the Lord Lieutenant in Ireland.

Clause 4 enacts that purchasers of articles of food and drink may, wherever there is an analyst appointed under this act, have any such article analysed for not less than two shillings and sixpence, nor more than ten shillings and sixpence, and receive a certificate according to the results, such certificate duly signed being sufficient evidence (in the absence of any evidence to the contrary) of the matters therein certified.

Clause 5 empowers the justices before whom any complaint may be made to cause any article to be examined and analysed by such skilled person as they may appoint for the purpose, who may be required to give evidence at the hearing of the case, the expense of this examination and analysis to be paid by the complainant or party complained against according to the result.

Clause 6 gives the right of appeal to the quarter sessions against any conviction under the Act; and clause 7 allows the postponement of the hearing when the conviction takes place within six days before the sessions.

Clause 8 allows persons convicted of selling any adulterated patented article to have a case stated for the opinion of one of the superior courts of law.

Clause 9 relates to the modes of procedure and the application of the fines.

Clauses 10 and 11 contain special provisions relating to the modes of procedure in Ireland.

Clause 12 directs from what sources the expenses of the execution of the act are to be paid.

Clause 13 is as follows: "Nothing in this act contained shall be held to affect the power of proceeding by indictment, or take away any other remedy against any offender under this Act."

The 14th and last clause contains a special protection for druggists and spirit merchants. It declares that in the construction of the Act the words "articles of food or drink" shall include not only all alimentary substances solid and liquid, but also all eatables and drinkables whatsoever, *not being medical drugs or articles usually taken or sold as medicines*, but shall not be construed so as to affect the reduction of the strength of spirits by persons licensed under the excise.

PHARMACY, TOXICOLOGY, &c.

On a Means of Estimating the Amount of Impurity in Pulvis Ferri, or Quevenne's Iron, by HARRY NAPIER DRAPER, *F.C.S.*

TEN grains of the sample are weighed and introduced into a small flask, with four times its weight of iodine in fine powder, and half an ounce of water. The mixture is heated, and when the action has terminated the flask is filled up with water and its contents transferred to a filter. When the fluid has passed through, any excess of iodine is dissolved out by a solution of *pure* iodide of potassium, and if any residue exist it is well washed with distilled water. If the impurity consist of oxide of iron only, it is dissolved in dilute hydrochloric acid, boiled for a minute with a small addition of nitric acid, and precipitated as sesquioxide by ammonia, washed, dried, and weighed. If carbon or silica exist they will of course be discovered when the portion which is not acted upon by the iodine is treated with hydrochloric acid.

Dublin.

Pharmaceutical and Toxicological Notes.

Influence of Neutral Salts on the Solubility of Quinine.—Sal ammoniac, nitrate of potash, and sea salt, M. Calloud asserts[1], greatly increase the solubility of sulphate of quinine. The sulphates of soda and magnesia on the contrary diminish the solubility. The bicarbonate and phosphate of soda wholly or in part decompose the quinine salt. Pure quinine easily dissolves in water which contains a small quantity of sal ammoniac. M. Calloud's experiments were made with a mixture of 80 parts of distilled water, 1 part of sulphate of quinine, and 4 parts of each of the salts employed.

Hydrated Sesquioxide of Iron as an Antidote for Arsenious Acid.—M. Fasoli[2] has made several experiments on small dogs in good condition to ascertain the value of the hydrated sesquioxide and hydrated sulphide of iron as antidotes in cases of poisoning by arsenious acid. He poisoned nineteen dogs with varying quantities of arsenious acid. Of these, five to which no antidote was administered died. Of the other fourteen, which were treated with the antidotes, twelve recovered and only two died.

We have no details of the experiments, and so have no means of estimating their value.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On the Animal Product Collection in the Museum, by ED. LANKESTER, *M.D. F.R.S.*

LECTURE VI. *On Waste.*

(*Concluded from page* 105.)

Then, suppose you had used your animal charcoal, and that it had become blocked up, what are you now to do with it? You cannot reburn it: but although it will not bear that process, it still contains phosphate of lime; it still contains that precious constituent which forms part of our bones, and the bones of the lower creatures. We must have that, and where are we to get it from? The bread which we eat from day to day must have it. And where is the bread to get it from? Why, from the land on which it grows. If the land will not grow wheat and the meadows grass, they must be made to do so. The soil may become exhausted, and has again and again been exhausted. We have instances of farms which have ceased to grow wheat because they have no more phosphate of lime, and of meadows which fail to grow grass because of the want of this phosphate. Then how can the farmer remedy this? In no way but by applying the phosphate to the soil; and this he may do by apylying to his land the refuse of our towns. But we may

[1] *Répert. de Pharm.* t. xvi. p. 177.
[2] *Comptes-Rendus*, t. li. p. 172.

throw away our phosphate, we may pour it into our sewers and rivers, and thus destroy it, whilst our crops are exhausting our fields;—and this is the history of the great empires of antiquity. Why have they ceased to exist? History will give you a variety of reasons; but you will find around the great cities of antiquity, of Africa, of Asia, and of Europe, that the soils have become exhausted of their phosphate of lime, and consequently their crops have failed. Man could not then bring his food from great distances, and on this account the great cities of antiquity have been depopulated, and new colonies have sprung up in every part of the world. Within the last few years the chemist has shown man how he can avoid this necessity. It has pointed out that we have in these decaying bones the material of future life: it has shown us that in the earth are the bones of extinct animals containing this precious phosphate of lime. In the form of coprolites and phosphatite, we now get this phosphate of lime from the green sand of Cambridge, the red crag of Suffolk, the lias of Gloucestershire, the weald of Sussex and the Isle of Wight. This phosphate, in a mineral form, has also been found in Estremadura, in Spain, that country of never-ending wealth. There it exists in thousands, tens of thousands, probably millions of tons; although Spain has not yet arrived at a knowledge of the importance of this substance, and sends little or none into the markets of Europe. We get it, however, from Sweden and Norway, and other parts of the world. And here we have an instance of the use of that which previously had no value being made subservient to the highest purposes in the life of man.

The dust of bones and ivory is sold in the shops, and used for various purposes. Ivory filings are collected most carefully by the ivory-turner, and sold as ivory-dust. Jellies are made from ivory-dust, and they are supposed to be more nutritious than jellies made from other things. I have, however, told you, in previous lectures, that gelatine is not nutritious. However, we have in this ivory-dust phosphate of lime, and it may be that a portion of the phosphate is thus introduced into the system. Then, bone-shavings are used as a substitute for ivory-dust, and are employed for the purpose of making a jelly, which is frequently administered to the sick.

Passing on from these manufactures, I come to a curious instance of the application of refuse to purposes in the arts. If you recollect what I said more particularly with regard to the preparation of cloth, you will remember that I stated that soap was frequently employed for the purpose of washing away the oil and other impurities in the wool. Now, this soap is used in such large quantities that soap-suds have become a source of annoyance in the rivers in cloth-manufacturing towns; and it has occurred to chemists that if the materials of the soap could be collected they are of considerable value; and in some places there are arrangements made for arresting the suds, which contain both potash and oil in large quantities. When collected, sulphuric acid is added to the suds, and the soap is thus decomposed; the potash and the soda go to the sulphuric acid, whilst the fatty matter floats on the top; and in this way thousands of tons of useful matter are rescued from loss. The fatty matter which rises to the top of these soap-suds is skimmed off and made into soap again, or into candles, or converted into other products in which fat is used.

Now, let me call your attention to another process. The fragments of woollen clothing, bone drillings, whalebone shavings, hoofs and horns, button-makers' refuse, horn shavings, dried blood, woollen waste, all sorts of animal products, the sweepings of manufactories, the lost atoms, which could not be used or employed for anything else in the respective manufactories, are used for making crystalline salts, known by the name of *prussiates*. There are two of these prussiates generally known; one is a beautiful yellow salt, the other is an equally beautiful red salt.

And what are these prussiates? It is just worth while studying them for a moment, to see what curious compounds result from animal chemistry. The word prussiates come from prussic acid (which comes from Prussian blue), which is also called hydrocyanic acid, and which is composed of hydrogen and cyanogen, and the latter is a compound of carbon and nitrogen. Old scraps of iron are collected together, and with potash and animal matter form these prussiates.

In order to obtain these salts, we take three sets of substances:—1. Refuse of animal substances—blood, bones, hoofs, horns, &c. which yield nitrogen and carbon. 2. Old scraps of iron; and 3. Potashes, the refuse, if you like, of hewn trees; and these supply the potassium. Now, when these things are exposed to heat together, they arrange themselves in this way:—the iron unites with the carbon and nitrogen in the form of cyanogen, forming ferro-cyanogen, and this compound unites with the potassium, forming the ferro-cyanide of potassium; and this is what these salts are—ferro-cyanides.

I will not go further into the history of these prussiates, but just say a few words about their use. I do not know that there is any use for this prussiate of potash alone; but let us see how it acts in combination with iron. There are two proportions of cyanogen, and two proportions of potassium, and one of iron. Now, if we take a solution of iron and add it to a solution of this yellow salt, this prussiate of potash, it will be converted into a beautiful blue substance. This is Prussian blue, Berlin blue; and it is the base of all the blues that are known by that name, and the base of many other colours also. What is this Prussian blue? Why, it is a ferro-cyanide of iron. We displace the potassium by the addition of the iron, and thus form this important dyeing material. This is obtained, then, from waste made up of the sweepings of our manufactories, the refuse of our slaughter-houses, and blood and filth of all kinds. Man comes in, you see, as creator, builds up the elements, and makes all these beautiful colours with which he dyes his silk, and makes blues for his calicoes and other materials.

Now, there are many other things which I might speak of in connection with this large subject. I might show you that some materials which look unlikely to be employed in the arts for any useful purposes have been employed in that way. Recently there has been an attempt to use the substance which we know by the name of guano. We bring it over to this country on account of the phosphates which it contains. A series of beautiful colours have been obtained from this guano. If we take a little of it and mix it with nitric acid, we shall find that it will produce the beautiful colour of murexide. A few years ago, the test of the action of nitric acid upon the substances contained in guano was merely an amusement or chemical test; nobody ever thought of using it in the arts. But now, these substances are manufactured in large quantities, and guano is used successfully in the arts.

These beautiful colours depend upon the lithate of ammonia. When we add nitric acid to this substance, the purpurate of ammonia, or murexide, is produced. According to the way in which the guano is heated, will be the variety of results obtained. This is just one of a hundred applications of chemical knowledge to substances having a similar nature to guano.

I was asked the other day whether I had ever seen the colouring matter produced from an insect (*Cimex lectularius*) uncommonly disliked in this country. Some one in Australia, it was stated, had taken out a patent for procuring a beautiful colouring substance from this little creature.

Speaking of insects and their products, I must here remind you that to the insect tribe we are indebted for chloroform—one of the most powerful agents in alleviating human pain. The little ant contains a substance called formic acid, about which old John Ray and Martin Lister corresponded a century ago; and they found that it contained an acid; and so it got into books as formic acid. It was found to be composed of a compound radical, formyle, and three atoms of oxygen. Dumas substituted chlorine for the oxygen, and thus obtained terchloride of formyle, which is chloroform. Then the Americans found that ether was capable of taking

away all sensation from the human body; and Dr. Simpson of Edinburgh found that terchloride of formyle was more thoroughly adapted for this purpose than even ether. All this has arisen from a study of the habits of insects. There is no telling but that every insect has some use in relation to man. Such facts are inducements to study. Be not dismayed by obtaining no immediate results. Surely it is some reward, even if we do not get a money payment, to feel that we have not lived in vain; that we have exerted our brains to the utmost to fulfil the mission that God sent us to perform on this earth; and that we have left the world wiser and better for our work in it.

Now I must cease my illustrations. The subject is a large one, and I hope some day again to bring it before you. I have before said there is no part of an animal which is not of use; so when they are dead they ought not to be buried or cast away. The value of a dead horse is not a large sum,—from 20*s.* to 60*s.* on an average; but recollect that every application to art or science of this dead horse renders him of greater value; and it is for us, engaged in various ways in the arts of life, to see whether we cannot apply things that have hitherto been wasted. Five hundred horses die every week in London. The hair is worth from 8*d.* to 1*s.* per lb. and it is used for making hair-cloth, for stuffing mattresses, and making plumes, and bags for crushing seed in oil-mills. Then the hide weighing 30 lbs. is worth 8*s.* which is perhaps not a great deal of money; but when you have from 300 to 500 a week dying within a radius of five miles from Charing Cross it comes to some money. Then the skin is used for a variety of purposes; tendons you know may be made into gelatine, and glue, and jellies. I told you that you must not be particular about these jellies: when the poor old horse has drawn your carriage, served you in omnibus and cab, and died at last, even then you have not done with him, for his tendons may then serve you for your delicious jellies. Then again it is not an uncommon thing for man to eat horse-flesh. We do not eat it here knowingly, but they eat it on the continent of Europe. Then there is the blood, which is carried to the prussiate of potash manufacturers. Then there are the internal tubes, which are used for the coverings of sausages; and, as I said of the jellies, we need not ask any questions about these coverings as long as they are sweet. The heart and tongue are evidently great "mysteries," for no one knows what is done with them. There is almost as much mystery about them as about the manufacture of the cloth of your coat. The heart, however, can be chopped up and mixed with sausage meat, and the tongues may be sold for ox-tongues. On one occasion, when I stated this fact, a newspaper reporter who was present told me that it was all a mistake, and that the tongues were never sold for so inferior an article as ox-tongue. They were always sold as reindeer tongues. Now, passing over the fat, which is worth 3*s.* 4*d.* I need not tell you that horses' bones are as good as any other bones, and can be employed for the various purposes to which other bones are applied. The bones of a horse weigh about 160 lbs. and are worth 4*s.* 6*d.* per cwt. Then there are the hoofs, 6 lbs. of these at 8*s.* to 10*s.* per cwt. which can be used for making buttons, prussiates, and snuff-boxes. I do not think that it is correct to say they are used in making glue. I think horses' hoofs are composed of the same material as hair. They are sold, it is true, to the glue-maker, but he sells them to the prussiate manufacturer. Even the poor old shoes are worth from 5*s.* to 10*s.* per cwt.; and even with regard to all these substances employed, there is nothing which cannot be used again and again.

With this Lecture I finish this part of my course. I have endeavoured to bring before you very hastily some of the chemical principles in operation in the arts and manufactures. I have also endeavoured to point out to you the natural history of these things, and have done so for the purpose of impressing upon your minds the importance of studying the structure and habits of the animals used by man. I think a civilised community ought to study the history and properties of those things to which they are so much indebted for their comfort and advancement. It is just in proportion as a larger number of the population get interested in the study of the nature and properties of the objects of the external world, that the arts and manufactures will be advanced. Whatever may be the occupation of a man, he will be much more likely to be successful in it if he has an intelligent apprehension of the nature of the materials which he uses from day to day. If this were better understood, there would be a much greater demand for a special knowledge of the nature and properties of the substances used in our arts and manufactures than has hitherto been evinced. You know that the Government of this country is making, with this institution, an effort to diffuse science-education throughout the country. But this effort will be vain unless it is supported by the public.

NOTICES OF BOOKS, PATENTS, &c.

The History and Properties of the Different Varieties of Natural Guanos, by J. C. Nesbit, *F.G.S. F.C.S.* London: Rogerson and Tuxford, 1860.

This is a work for farmers and manure dealers, and not for chemists. By the former classes it will no doubt be found a very useful little work, containing as it does a succinct account of the different kinds of guanos, together with some hints for their application, and some cautions against the frauds so common in the manure market.

Analytical chemists are often required to fix the money value of a manure, and the values generally assigned to the different constituents are those estimated by Mr. Way some years ago. Mr. Nesbit's figures, however, differ slightly from those of Professor Way, and (as it is not right that chemists should differ in their results without knowing the reason why) we quote them for the information of our analytical readers. Mr. Nesbit estimates

Ammonia	at 60*l.*	per ton.
Phosphate of lime (insoluble)	8*l.*	,,
,, ,, (made soluble)	24*l.*	,,
Organic matter	1*l.*	,,
Alkaline salts	1*l.*	,,
Sulphate of lime	1*l.*	,,

It must be observed that among alkaline salts at 1*l.* per ton, Mr. Nesbit does not include the salts of potash, concerning which by the way we find the following curious remark:—

"A few isolated experiments prove potash to be of some value in one or two crops, but as this substance can readily be bought in a state of tolerable purity as sulphate or muriate of potash, we shall not give this any agricultural value further than as comprised under the term of alkaline salts."

Mr. Way set down the value of potash at 60*l.* per ton, and it is no doubt of very great use in a turnip manure. Our space, however, will not allow us to discuss the value of potash with our author.

In his future analyses of guanos we should be glad to see Mr. Nesbit follow up the investigations of Boussingault on the presence of nitrates in those manures. It is a question of considerable chemical interest, and if Boussingault's results were confirmed it would certainly tend to raise the value of the earthy varieties.

CORRESPONDENCE.

Hints for the Prevention of Accidental Poisoning.

To the Editor of the Chemical News.

Sir,—The consideration of the subject of poisoning by accident or mistake is revived every now and then when a case occurs, like that reported in the Chemical News for

July 28; it is, however, soon forgotten, until another victim falls under the the present system of dispensing and vending poisonous medicines. With the hope, however, of preventing such accidents, we beg leave to make some suggestions which, if adopted, we believe would form an efficient safeguard against the repetition of similar occurrences.

The Act to Amend the Law relating to the Unlawful Administering of Poisons, passed by the Government in February last, supplies a great defect in our criminal law, and will no doubt do much to prevent the perpetration of such offences as that which was the immediate cause of its enactment; but it does nothing to affect the indiscriminate sale of poisons, and makes no attempt to provide against what are called "accidental poisonings." Former attempts at legislation on this matter have failed, because of the impracticability of the measures which have been proposed. The authors of such measures have constructed schedules of poisons from which more dangerous substances have been omitted than any included; and they have attempted to place restrictions on the sale of articles in such constant demand amongst artisans of all classes, as to make it utterly impossible to carry the law into effect. With the sale of those poisons in constant use amongst artists, mechanics, and others, we believe it to be as impossible to interfere as with the sale of lucifer matches, which are now the favourite instruments of suicide and murder in France and Germany. But the "accidental poisonings"—those cases in which a druggist sells a customer laudanum for tincture of rhubarb or black-draught, or in which a relative or nurse administers to a patient a poisonous external application instead of a mixture, or gives two tablespoonfuls of some active medicine instead of a teaspoonful — these we believe to be easily preventible.

The first step should be taken in the druggist's establishment. He might fairly be required to keep all poisonous matters in vessels of some peculiar construction. But here occurs the question — How shall we decide on what are to be considered poisonous matters? The want of a satisfactory answer to this question led some of those who have attempted to legislate on the subject into some absurdities. They made an arbitrary selection of several articles which were well known to be poisonous, and directed these to be secluded in a "poison closet," leaving others perfectly free which were just as dangerous. They omitted to lay down any rule which could serve as a guide in deciding what ought and what ought not to be considered a poison. Now we believe it is perfectly easy to give such a definition as might serve for the basis of legislation — a definition which shall include all known substances, and any others which may be hereafter discovered and introduced into medicine. It is clear that such a definition can only be based on the dose. The line between danger and safety is sometimes very narrow, and doctors themselves differ about poisonous doses; but we believe we shall lay down a rule capable of universal application when we say that every liquid should be considered as poisonous the maximum dose of which for ordinary therapeutical purposes does not exceed one drachm, and every solid substance the maximum dose of which does not exceed five grains. All such liquids and solids vendors should keep in such vessels as would indicate the dangerous nature of their contents, and this, we believe, would effectually guard against one class of accidents. It is just as easy to provide against the others. Most external applications are dangerous if swallowed, and consequently these should be placed in bottles of a distinctive shape, which would prevent their being mistaken for medicines to be taken internally.

There is but one other source of danger to be guarded against, and that is, the possible administration of an overdose of some powerful medicine. This might be easily prevented by the use in such cases of bottles of the same peculiar construction as those in which it is proposed to keep poisons on the druggists' shelves; and we are of opinion that the bottles with contracted necks are well suited for both purposes, affording, as they are acknowledged to do, sufficient indication to dispenser, nurse, or patient, of the potent nature of the medicine.

If these precautions were adopted, in our opinion accidents could only happen from ignorance or criminal carelessness, for which individuals may be fairly made responsible; and there can be no doubt that a system founded on the principles we have laid down would most effectually prevent a class of poisonings which are unhappily too often a scandal to medical men and druggists, and a source of grief to their patients and customers.

We have not touched upon the question how chemists and apothecaries are to be brought to adopt the scheme proposed —whether it should be by Act of Parliament or otherwise; but we are strongly inclined to the belief that a simple recommendation emanating from either the Home Office or the Royal College of Physicians would be sufficient. The best and most respectable portion of the fraternity would immediately act upon it, and the rest would ultimately follow their example. A system of safeguards so recommended in the public behalf would unquestionably be insisted upon by the physic-taking public; and when once become an *established custom*, any neglect of or departure from its provisions would imply such an utter want of ordinary care and prudence as to be altogether without excuse and deserving the severest punishment.

In conclusion, perhaps you will allow us to make known to those parties who, in consequence of the allusion you were pleased to make to our newly-invented bottles have addressed to us letters of inquiry on the subject, that, apart from the public advantage which we firmly believe would follow the general use of these vessels, we have no interest whatever in the matter. Anyone may get information, and purchase the bottles upon exactly the same terms as ourselves, by applying to Mr. Toogood, 37 Mount Street, or to Messrs. Maw, Aldersgate Street. To those who may entertain doubts as to the practicability of the plan we have proposed, we may say that it may be seen here in full operation, and we shall be pleased to receive a visit from all who may wish to satisfy themselves upon that point.—We are, &c.

SAVORY & MOORE.

New Bond Street, Aug. 12, 1860.

The Sale of Poisons.

To the Editor of the CHEMICAL NEWS.

SIR,—I am induced by the perusal of your article on the above subject in the CHEMICAL NEWS of the 11th inst. to forward to you the following practical suggestions, which, if you will admit them, will find a fitting place in your columns.

It is surprising that in regard to a subject of such great public importance as the *sale of poisons*, no restrictive measures have yet taken effect. It is clearly the duty of the Legislature to regulate and control the sale of poisonous drugs; a bill framed with that intention has been on several occasions presented in Parliament, passed through some stages, but finally withdrawn, chiefly on account of the violent opposition by pharmaceutists to any legal restrictions whatever; and so the chemists are left free as before to dispense their deadly drugs without limit or penalty.

In order, however, to guard against the frequent and disastrous cases of poisoning, it is necessary that some plan should be adopted by which chemists may be made responsible for their acts, and some penalty inflicted on the reckless vendor.

Such a plan will be presently proposed.

In order thoroughly to understand the merits of the question, it may be worth while first, to examine the nature of the objections offered to legal restrictions. This will be done very briefly.

It is well known that the chief opponents to any legislative enactment concerning this matter are the chemists and druggists, represented by the Pharmaceutical Society. They talk of raising the educational status of chemists as

the only means available for checking the present fearful amount of accidental poisoning; they intimate that the pharmaceutists, as a body, are aiming at that object, and therefore all other measures are unnecessary; they ask, in fact, that the whole question should be submitted to their decision and placed under their control.

The attempt to improve the education of chemists is very laudable, but it is a slow process, and at best it would benefit but a comparatively small number of those who have the indiscriminate handling of poisonous substances. It is argued as an objection that "if the Sale of Poisons Bill had passed, half the chemists shops must have been closed:" that is just the effect that is most to be desired, and which would promote in no small degree the public safety, for there are too many at present by *more than half*. The number of incompetent persons engaged in dispensing deadly and other drugs as "general dealers," &c. far exceeds that of intelligent and educated chemists, and it must appear to any one who will give a thought to the subject, that the more miscellaneous the character of the articles sold over the counter with dangerous drugs, and the greater the number of hands employed in such heterogeneous dealings, the greater is the risk to the public.

Then again, it is a great mistake on the part of the pharmaceutists, when they say that *intentional* poisoning — by murder or suicide—is the chief object to be guarded against; they argue therefore that "any restrictions designed to affect the sale of poisons would be as inoperative and as futile as would be an attempt to prohibit the sale or the purchase of knives, daggers, pistols, and all the weapons that are in general made use of to take away life."

But not to follow out these arguments further, I will at once arrive at the chief object of this letter, viz. to suggest a means by which an immediate, and I think, an effectual check, may be put upon reckless dealings in poisonous drugs.

It appears that many difficulties surround the attempt to pass a bill to restrict the sale of poisons; some of these are of a theoretical, some of a practical character — difficulties which Parliament has seemed unwilling to encounter, or at any rate no great exertion has been made to surmount them.

There can be, however, no objection to the plan about to be proposed, it is this:

In case of death from poisoning, the chemist who supplied the deadly drug should be summoned to appear at the inquiry held before the coroner, and if it should be proved by the evidence that the said chemist had not used proper precaution in supplying the poison, *i. e.* without question or direction, or if there had been culpable carelessness in selling the wrong drug, he should be convicted of *manslaughter*; or some such verdict should be returned against him, adequate to the nature and extent of his offence, and in severity as great as the law would permit.

This decision concerning the chemist — under the circumstances stated — should be entirely independent of the verdict or opinion respecting the person who administered the deadly drug; the latter might be considered guilty either of murder or of manslaughter, or might only be deserving of censure for carelessness, or might even be dismissed blameless — but the chemist in each and every case should be held responsible for his act, as *a criminal party concerned, having been, though a secondary, yet an active agent in causing death.*

It must be evident that such an arrangement—the certainty that justice awaited them—would tend in no small degree to check the reckless handling of drugs by chemists, for which they appear now wholly irresponsible.[1] Some more practicable and efficient plan may, after deliberation, be found than the scheme herein suggested; but it is *most* important and *most* urgent that something should be decided on speedily, by which the fearful sacrifice of life by accidental poisoning may be stayed, which is a disgrace to an enlightened and a humane people.—I am, &c.

PRO BONO PUBLICO.

[1] It is now entirely depending on the *discretion* of the coroner whether the chemist be or be not summoned to appear at an inquest on a case of poisoning. Two instances occurred recently at Brighton in each of which the chemist had supplied *syrup of poppies* in large quantities, neither asking question nor giving direction. The drug was administered in each case to a young infant by the mother in utter ignorance as to its deadly nature. The poor mother was censured for her ignorance, but nothing was said concerning the carelessness of the chemist, although it appeared during the investigation that it was supplied in a very reprehensible manner.

The writer of this paper suggests that the coroner should not only have the power, but that he should be *compelled*, to summon a chemist at an inquest under similar circumstances to the above.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Influence of Temperature on the Colour of Saline Solutions.—Schönbein observed some years ago, that solutions of the salts of peroxide of iron became of a deeper colour when they were heated. Since then Dr. Gladstone has published some observations of the same kind in the case of other salts. Schiff now confirms the general fact, but gives some exceptions. When sulphocyanide of potassium is added to a solution of perchloride of iron, a liquid is obtained the colour of which decreases as the temperature rises. When boiling the colour scarcely differs from that of a boiling solution of perchloride of iron. A solution of pure sulphocyanide of iron, on the contrary becomes of a deeper colour when it is heated. The diminution of the colour in the first case is no doubt due to an inverse double decomposition determined by the elevation of the temperature.

Solutions of the sulphocyanide of potassium and chloride of cobalt added to alcohol are coloured blue when warmed; the sulphate, however, remains red, or only takes a deeper tint. A solution of the sulphate of cobalt, to which a few drops of sulphocyanide is added, takes a very deep red tint in the cold, and when heated the liquid does not become blue; on the contrary, its red colour diminishes to nearly the same tint as the solution of the sulphate. From this it seems probable that at a certain temperature the sulphocyanide of cobalt and sulphate of potash which were formed at the ordinary temperature, are again changed into the sulphate of cobalt and sulphocyanide of potassium.

When chloride of calcium is added to the same hot solution (sulphate of cobalt and sulphocyanide of potassium), it is instantly coloured blue. Sulphate of lime is precipitated and chloride of cobalt is formed, to which no doubt the blue colour must be attributed. When sufficient chloride of calcium is added, the blue colour remains after the solution becomes cold, and as we know that chloride of cobalt and sulphocyanide of potassium are decomposed in the cold into chloride of potassium and sulphocyanide of cobalt, it seems natural to ascribe the colour of the cold solution to this latter salt. These facts may be quoted as fresh examples of the influence of heat in modifying chemical affinity.

Mineral Constituents of the Tillandsia Dianthoides.—Some of the Tillandsias are air plants and will grow away from immediate contact with the soil. M. S. de Luca[1] has analysed the Tillandsia dianthoides for the mineral constituents, and finds them the same as are found in ordinary plants growing in the earth, viz. lime, magnesia, potash, silica, soda, and phosphoric acid, with traces of iron, alumina, and manganese, as well as sulphuric acid and chlorine. He supposes that these matters derived from the dust which floats in the air, are deposited on the outside of the leaves, and pass into the vegetable organism to be assimilated by the action of the carbonic acid, ammonia, and moisture of the atmosphere.

Is there Iodine in the Atmosphere?—With the view of deciding this question, De Luca[2] collected rain-water on the top of the leaning tower at Pisa, on several days at different seasons of the year, evaporated it carefully to dryness with pure carbonate of potash, then tested for iodine, and in no instance found a trace.

[1] *Comptes-Rendus*, t. li. p. 176. [2] *Ibid.* p. 177.

Permanganic Acid.—M. Personne[3] has written to the Academy of Sciences to say that he published in 1851 an account of the acids of manganese, which contained analyses of the permanganates of potash and silver, fully confirming the composition assigned to these salts by Mitscherlich.

II. ORGANIC CHEMISTRY.

Transformation of Olefiant Gas into Complex Organic Acids.—We must content ourselves here with announcing the fact that Wurz[4] has succeeding in forming a new acid, isomeric with malic acid by the oxidation of diethylenic alcohol, and has also transformed triethylenic alcohol into a still more complex acid.

Pyocyanine.—Pus, in certain rare cases, is seen to stain the dressing rags blue. M. Fordos has collected rags so stained, and has succeeded in extracting from them some blue matter to which he gives the name of pyocyanine. The process he employed for the purpose was the following: — He macerated the rags for some hours in slightly ammoniacal water, and then shook up the greenish blue solution obtained with chloroform, which separated the colouring together with some fatty and other matters. The chloroform solution was separated and left to evaporate, and the residue was treated with distilled water, which dissolves the pyocyanine and leaves the fatty matters. This solution is again agitated with chloroform, and the chloroformic solution is again separated and allowed to evaporate. The residue is the pyocyanine still contaminated with some yellowish foreign matters. A few drops of hydrochloric acid changes the pyocyanine into a red substance, and now chloroform dissolves the foreign matters and leaves the red compound of pyocyanine and hydrochloric acid. This, when sufficiently purified, is triturated with carbonate of baryta in the presence of chloroform, whereupon the pyocyanine is set at liberty and is dissolved by the chloroform; and the chloroform solution, filtered and evaporated, yields microscopic blue prismatic crystals of the new body.

Pyocyanine, the author says, is altogether different from *biliverdine*, which some have considered the colouring matter of blue pus; it differs also from *cyanurine*, found by Braconnot in a blue urinary deposit, and also from the blue matter found in the bile by Chevreul, and in the blood by Lecanu.

A solution of pyocyanine containing pus loses its colour when kept in a closed bottle, but when agitated in the air retakes its original blue. It is also decolorised when heated in a test tube with a solution of sulphide of sodium, the blue colour being restored by agitating in the air. These facts show that pyocyanine, like many other colouring matters, becomes colourless under the influence of a deoxidising agent to retake its colour when in contact with the oxygen of the air, and explain how a colourless pus may nevertheless stain the dressing rags blue.

III. ANALYTICAL CHEMISTRY.

Separation of small quantities of Lime and Magnesia.—The method of separating lime and magnesia by means of oxalate of ammonia does not succeed when the lime present in the mixture is a very small amount. In such a case the lime is either not precipitated at all or but very incompletely. Free ammonia assists in hindering the precipitation, and when it has evaporated crystals are obtained, which consist of oxalate of lime with oxalate of magnesia, and the liquid still contains lime. A better result, Scheerer says, is obtained by converting the alkaline earths into neutral sulphates, and adding alcohol to the aqueous solution until a persistent cloudiness is produced. After some hours all the sulphate of lime is deposited. When too much alcohol has been used, some of the sulphate of magnesia is deposited as well; it is sufficient then to redissolve the sulphates in water and precipitate a second time with alcohol; or the lime may now be thrown down by the oxalate of ammonia. The magnesia not being in excess, no longer hinders the precipitation.

[3] *Comptes-Rendus*, p. 214. [4] *Ibid.* p. 162.

MISCELLANEOUS.

Poisoning by a Wife. — Extraordinary Remedy for Toothache. — The *Lincolnshire Herald* reports that a labouring man named Dodds died somewhat suddenly at Wrangle, a few days ago. He had been attended by a surgeon for a slight illness, and on the 21st July his wife went to the doctor, to inform him that her husband was better. She received a tonic to complete his convalescence. As she returned home Mrs. Dodds called at the shop of Mr. Cherrington, druggist, &c. of Leake, *and asked for a quarter of a pound of arsenic, stating that her husband was suffering from a severe toothache, and required it to relieve the pain.* After some little hesitation, she was supplied with the arsenic, being well known. The man died the next day (from English cholera as it was supposed) and was buried. Eventually, however, the body was exhumed, an inquest was held, and medical evidence being given that arsenic was the cause of the death of the deceased, a verdict of "Wilful murder" was brought against the wife.

We hope there is some mistake in the above report. We cannot conceive of a druggist selling a quarter of a pound of arsenic to relieve the toothache.

Foreign Matter in the Lungs.—"If you examine," says M. Pouchet, "the bodies of animals who live in our towns, and in our houses, you will be astonished at the enormous quantity of starch contained in their respiratory organs. In birds you will find it even in the middle of their bones. Particles of soot, filaments of the different kinds of textures of which our clothes are made, are also found there in great abundance. But the further the animal lives from a town, the more scarce become these bodies. In animals and birds living in the midst of forests, you will scarcely find any at all of them; in their case the respiratory apparatus is, on the contrary, filled with a large quantity of vegetable *débris*, chlorophylle, &c. I have found in the lungs of man the same atmospheric corpuscles as in animals. I found in two persons who died in one of our hospitals — a man and a woman — and whose lungs I injected, a notable quantity of fecula, normal, or after panification, particles of silica, and fragments of glass; fragments of painted wood of of a beautiful red colour; *débris* of clothes, and a larva of a microscopic arachnis still alive."

Malleability of Gold.—Gold, as is known, is the most malleable of metals; it is so to a degree of which it would be difficult without ocular illustration to form an idea. The gold beater makes it into leaves which, thanks to the progress of his art, are now so thin that 14,000 form only the thickness of a *millimetre*, and consequently 14,000,000 of leaves laid upon one another would make a thickness of only a *metre* (39 inches). A cubic metre of solid gold which would not weigh less than 680,440 ounces would suffice to gild a surface of 3450 acres, and 35,300 ounces would cover 179 acres. It is a result which confounds the imagination. And yet the metal used in the manufacture of gold lace is spread over a much larger surface. The substance of the threads of which this lace is made consists of silver, the surface alone being gold, and one *gramme* of gold worth 2*s.* 10*d.* suffices to gild a thread 120 miles in length. In a piece of 20 fr. (16*s.*) there is gold enough to cover a thread which would extend from Calais to Marseilles.—*Chevalier, Probable Fall in Value of Gold.*

A small Laboratory.—Dr. Wollaston had a peculiar turn for contriving pieces of apparatus for scientific purposes. By means of his reflective goniometer crystallography has acquired a great degree of perfection; and his sliding rule for chemical equivalents furnishes a ready mode for calculating the proportions of one substance necessary to decompose a given weight of another. The Doctor was accustomed to carry on his experiments in the greatest seclusion, and with very few instruments. His laboratory was sealed to even his most intimate friends. Dr. Paris relates that a foreigner once called on Wollaston with letters of introduc-

tion, and expressed an anxious desire to see his laboratory. "Certainly," he replied, and immediately produced a small tray containing some glass tubes, a blow-pipe, two or three watch-glasses, a slip of platinum, and a few test-tubes. Upon another occasion, after inspecting Mr. Children's grand galvanic battery, Wollaston, within a tailor's thimble, completed a galvanic arrangement by means of which he heated a platinum wire to a white heat

Recent Alchemy.—Within the last ten years has been printed in London a volume of considerable extent, entitled *A Suggestive Inquiry into the Hermetic Mystery*, 1850. This work, "a learned and valuable book," is by a lady (anonymous), and has been suppressed by the author. By this circumstance we are reminded of a concealment of alchemical practices and opinions some thirty years since, when it came to our knowledge that a man of wealth and position in the metropolis, an *adept* of alchemy, was held *in terrorem* by an unprincipled person, who extorted from him considerable sums of money under a threat of exposure. Nevertheless, alchemy has, in the present day, its prophetic advocates, who predict what may be considered a return to its strangest belief. The nineteenth century has not yet passed away, and Dr. Christopher Girtanner, an eminent professor of Göttingen, has prophesied, in a memoir on Azote, in the *Annales de Chimie*, No. 100, that it will give birth to the *Transmutation of Metals!* "In the nineteenth century," says the Professor, "the transmutation of metals will be generally known and practised. Every chemist and every artist will make gold; kitchen utensils will be of silver, and even gold, which will contribute more than anything else to prolong life, poisoned at present by the oxides of copper, lead, and iron, which we daily swallow with our food."—*From Timbs's Curiosities of Science*, Second Series, just published.

Economy of Fuel.—At the present day there is in Northumberland, between Seatonburn and the Coquet, probably the finest field of coal yet remaining in Britain. It is the splint coal of the mineralogist, but known at present, commercially, as Hartley coal. This coal possesses all the essential requisites for a good steam fuel, if properly made use of, which is by no means the case at present. T. H. Leighton has devised a mode of burning splint coal in steam-engine boilers by means of a blast. For this purpose he proposes to remove the fire-grate, and form the space left for the fire-place into a furnace, to be fed continuously with coal through tubes or hoppers kept closed at top. He proposes to apply the blast at two different points; one through the body of the coal, so as to keep the solid matter in an active state of combustion; the other to play over the surface of the coal, to consume the gaseous or volatile products, so that a continuous, uniform, and clear flame will be maintained through the tubes or flues of the boiler, so long as the blast is kept in operation, but this being stopped, the flame will immediately cease, while the solid portion of the coal will remain in an ignited but quiescent state. There is to be a further arrangement for removing, from time to time, the earthy residuum of the coal, through a small doorway left immediately below the lower blast pipe. A party strongly recommends to the proprietors and workers of the coal just alluded to, the formation of an association or company to purchase or hire a large steamer, to be employed in the coal trade between the Tyne and the Thames. This will afford an ample opportunity for testing, maturing, and perfecting the proposed arrangements for exhibiting the plan in regular operation to the government and the large steam navigation companies, and for demonstrating all the important advantages which must result from the adoption of this mode of combustion; for the latter purpose, practical engineers might make passages to and from the Tyne in the steamer, so as to note the rate of evaporation, consumption of coal, &c. Of course this plan would be only found practicable and convenient for operations on a large scale, or with ample space at command; but for railway locomotives, small steam boats, and for engines in confined situations, as also for the manufacture of glass, and some other manufacturing purposes, he proposes the use of the prepared fuel mentioned elsewhere. He would further strongly recommend the formation of a company to commence the manufacture of fuel, on an extensive scale, at once, so as to establish the principle while an ample supply of good bituminous, or strong coking coal, still remains in the country.

The Manufacture of Alkali.—Vapour of burning sulphur, nitrous gas, and steam, are inclosed in large leaden chambers, where they condense into liquid sulphuric acid. By means of this acid salt is decomposed, and thus sulphate of soda is obtained. A mixture of sulphate of soda, small coal, and chalk, is then exposed to considerable heat in a reverberatory furnace. In the first instance, the gas and carbon of the coal, abstracting the oxygen from the sulphate of soda, reduces it to sulphuret of sodium, which, fusing in contact with chalk, a carbonate of lime, the two bases mutually exchange their combinations, the lime becoming a sulphuret of calcium, sodium a sub-carbonate of soda. The mass is then drawn from the furnace into an iron mould, where it sets into a solid block; in this form it has been known under the several names of black ash, rough, or ball alkali, and British barilla. The soluble sub-carbonate of soda is then separated by washing with water from the insoluble sulphuret of calcium and the remains of the coal; these latter being turned out as refuse, and deposited in large masses, heat, and become extremely offensive. By the present mode of treating rough alkali, a partial decomposition of water occurs, which converts some of the sulphuret of calcium into a soluble hydro-sulphuret of lime. By an improved mode of lixiviation, the sulphuret of calcium might be preserved entire throughout, and afterwards applied to a most important purpose.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. D.—The best article on the subject we have seen is in Tomlinson's *Cyclopædia of the Useful Arts*, vol. ii.

Medicus.— Lagetta lintearia or Daphne lagetta. We have no account of the properties of this particular tree; but it belongs to the Thymeleaceæ or Daphne family, and the bark of most of these plants is acrid, irritant, and sometimes purgative, and the fruit of some of them is narcotic.

J. N. is thanked, but his suggestions are not sufficiently practical for publication.

Alpha.—1. The distillate perhaps condensed in the retort. 2. Glass is perfectly safe for the purpose. 3. The acetic acid distilled with the aniline. A long article by Kopp, containing very explicit directions for the preparation of aniline and the colouring matters is in type, and will be commenced next week.

A Constant Reader.—We know nothing that will destroy the smell of tar, and still leave it tar.

Ignotus.—Only by examination.

B.D.—We will make inquiries on the point.

Books received—*Dental Cosmos*—*The Technologist*.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Transformation of Olefiant Gas into Complex Organic Acids, by M. AD. WURTZ.[1]

HAVING succeeded in converting glycol into glycolic and oxalic acid, and propylglycol into lactic acid, I expressed an opinion, in my memoir on the glycols, that these latter bodies might be regarded as the alcohols of diatomic acids. The facts I now bring forward afford a new and unexpected confirmation of this view, and I hope they will also throw some light on the constitution of complex vegetable acids, which until now the organism of plants has had the exclusive power of forming synthetically.

Glycolic, lactic, and oxalic acids, which are derived from glycols by reactions analogous to those which change alcohol into acetic acids, are acids of very simple constitution; but such is not the case with those obtained by oxidising the complex glycols, which I have called *polyethylenic alcohols*. By oxidising diethylenic alcohol,

$$\left.\begin{matrix} C_2H_4 \\ C_2H_4 \\ H_2 \end{matrix}\right\} O_2$$

I have obtained an acid isomeric with malic acid, and in the same way I have changed triethylenic alcohol

$$\left.\begin{matrix} C_2H_4 \\ C_2H_4 \\ C_2H_4 \\ H_2 \end{matrix}\right\} O_4$$

into a still more complex acid.

The oxidation of diethylenic alcohol is easily accomplished, either by means of platinum black, or by the action of nitric acid; in the latter case, however, the reaction is very violent, and dense clouds of red vapours are disengaged. The acid liquid obtained when evaporated to dryness becomes a mass of crystals. These crystals I redissolve in water, then saturate the acid solution with milk of lime, boil, and filter, to separate a deposit of oxalate of lime which is formed. The filtrate deposits on cooling a salt of lime crystallised in long brilliant needles. When dried at 170° C. these crystals have exactly the composition of dry neutral malate of lime. They contain $C_4H_4Ca_2O_5+6$ atoms of water of crystallisation, which they only lose completely towards 160°. Almost insoluble in cold, they dissolve with difficulty in boiling water. A boiling saturated solution gives with a concentrated solution of nitrate of silver an abundant white granular precipitate, which increases as the liquid cools. The composition of this silver salt is expressed by the formula—

$$C_4H_4Ag_2O_5$$

which also represents the malate of silver. When mixed with water, and decomposed by sulphuretted hydrogen, the silver salt furnishes an acid liquor which, properly concentrated, deposits some large sized crystals. Thus isolated, the new acid presents itself in the form of large rhomboidal crystals, having a fresh acid taste. It is very soluble both in water and alcohol. Its composition is expressed by the formula—

$$C_4H_6O_5 + H_2O$$

The crystals effloresce in the air, losing one atom of water of crystallisation, which is also quickly lost in a vacuum or at 100°. When the dry salt is heated to 148° it fuses, and on cooling becomes a crystalline mass. At a higher temperature, between 250° and 270°, it decomposes and gives off a mixture of gases, a small part of which consists of carbonic acid, and which burns with a blue flame. The residue distilled over a naked fire gives a thick strongly acid liquid, which after some time becomes a crystalline mass, true pyrogenous acid.

The form of the new acid, the water of crystallisation it contains and which it loses by efflorescence, and its behaviour when heated, all these characters are sufficient to distinguish it from malic acid, of which, however, it has the composition and molecular complication. But there is one property in which it exactly resembles malic acid: when fused with hydrate of potash it gives off hydrogen and splits up into acetic and oxalic acids.

$$C_4H_4K_2O_5 + KHO = C_2K_2O_4 + C_2H\,KO_2 + H_2$$

When a concentrated solution of the new acid is divided into two parts, and one part is neutralised with potash and added to the other part, a precipitate is immediately formed which consists of an acid salt, but slightly soluble in water, resembling cream of tartar. This salt is anhydrous, and contains $C_4H_5KO_5$. Ignited in a tube it blackens and gives off the odour of burning sugar. A solution of it left exposed to air becomes mouldy.

The acid described the author believes to be identical or isomeric with the acid obtained by Heintz as a secondary product in the preparation of glycolic acid, by means of monochloracetic acid and hydrate of soda. To be certain however, we must wait for new experiments by Heintz, who has not yet examined the acid in the free state.

The oxidation of triethylenic alcohol by nitric acid, is attended with the same phenomena as the oxidation of diethylenic alcohol. When the acids formed are neutralised with lime, two salts may be separated by proper treatment. One, slightly soluble in cold water, is identical with the salt of lime previously described; the other, much more soluble in water, crystallises in silky tufts like asbestos. The composition of the latter is expressed by the formula

$$C_6H_8Ca_2O_6.$$

The aqueous solution gives a white precipitate with nitrate of silver, and the silver salt decomposed by sulphuretted hydrogen gives a liquid containing the new acid, which does not crystallise, but after evaporation remains in the form of a syrupy mass.

If we compare the composition of the polyethylenic alcohols with that of the acids formed from them by

[1] *Comptes-Rendus*, t. li. p. 162.

oxidation, we see between these bodies very simple relations analogous to those which exist between alcohol and acetic acid; a certain amount of hydrogen disappears and is replaced by an equivalent amount of oxygen. When glycol or ethylenic alcohol is changed by oxidation into glycolic acid, we may admit that the radical ethylene C_2H_4 is converted into glycolyle, C_2H_3O. In the same way we may suppose that in the oxidation of diethylenic alcohol the two ethylene radicals are both converted into glycolyle. Diethylenic alcohol thus becomes *diglycolic acid*. The acid formed from triethylenic alcohol is obtained by a reaction not less simple: two of the ethylene radicals are converted into glycolyle, while the third remains unaltered, and thus we obtain *diglycolethylenic acid*. These relations are shown by the following formula: —

$\left.\begin{matrix}C_2H_4\\H_2\end{matrix}\right\}O_2$	$\left.\begin{matrix}C_2H_2O\\H_2\end{matrix}\right\}O_2$
Glycol.	Glycolic acid.
$\left.\begin{matrix}C_2H_4\\C_2H_4\\H_2\end{matrix}\right\}O_3$	$\left.\begin{matrix}C_2H_2O\\C_2H_2O\\H_2\end{matrix}\right\}O_3$
Diethylenic alcohol.	Diglycolic acid.
$\left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\H_2\end{matrix}\right\}O_4$	$\left.\begin{matrix}C_2H_4\\C_2H_2O\\C_2H_2O\\H_2\end{matrix}\right\}O_4$
Triethylenic alcohol.	Diglycoethylenic acid.

It is conceivable that other acids may be formed by the oxidation of the polyethylenic alcohols. However that may be, those I now make known possess the same complex molecular constitution, and the characters of the vegetable acids properly so called. In conclusion I have only to remark that they have been obtained synthetically from olefiant gas, which has been changed successively into bromide of ethylene, into glycol, and into oxide of ethylene. By the condensation of all their elements, the oxide of ethylene and glycol have been converted into polyethylenic alcohols, and those finally into diglycolic and diglycolethylenic acids.

On the Relation between Boiling-point and Composition in Organic Compounds, by Hermann Kopp.

The author was the first to observe (in 1841) that, on comparing pairs of analogous organic compounds, the same difference in boiling-point corresponds frequently to the same difference in composition. This relation between boiling-point and composition, when first pointed out, was repeatedly denied, but is now generally admitted. The continued experiments of the author, as well as of numerous other inquirers, have since fixed many boiling-points which had hitherto remained undetermined, and corrected such as had been inaccurately observed. In the present paper the author has collected his experimental determinations, and has given a survey of all the facts satisfactorily established up to the present moment regarding the relations between boiling-point and composition.

The several propositions previously announced by the author were :—

1. An alcohol, $C_nH_{n+2}O_2$, differing in composition from ethylic alcohol ($C_4H_6O_2$, boiling at 78° C.) by xC_2H_2, more or less, boils $x \times 19°$ higher or lower than ethylic alcohol.

2. The boiling-point of an acid, $C_nH_nO_4$, is 40° higher than that of the corresponding alcohol, $C_nH_{n+2}O_2$.

3. The boiling-point of a compound ether is 82° higher than the boiling-point of the isomeric acid, $C_nH_nO_4$.

These propositions supply the means of calculating the boiling-points of all alcohols, $C_nH_{n+2}O_2$; of all acids, $C_nH_nO_4$; of all compound ethers, $C_nH_nO_4$. The author contrasts the values thus calculated for these substances with the available results of direct observation. The table embraces eight alcohols, $C_nH_{n+2}O_2$, nine acids, $C_nH_nO_4$, and twenty-three compound ethers, $C_nH_nO_4$; the calculated boiling-points agree, as a general rule, with those obtained by experiment, as well as two boiling points of one and the same substance determined by different observers. We are thus justified in assuming that the calculated boiling-point of other alcohols, acids, and ethers belonging to this series, will also be found to coincide with the results of observation.

The boiling-points of other monatomic alcohols, $C_nH_mO_2$, other monatomic acids, $C_nH_mO_4$, and other compound ethers, $C_nH_mO_4$, are closely allied with the series previously discussed. A substance containing xC more or less than the analogous term of the previous class, in which the same number of oxygen and of hydrogen equivalents is present, boils $x \times 14°{\cdot}5$ higher or lower; or, what amounts to the same thing, a difference of xH more or less of hydrogen lowers or raises the boiling-point by $x \times 5°$. Thus benzoic acid, $C_{14}H_6O_4$, boils $8 \times 14°{\cdot}5$ higher than propionic acid, $C_6H_6O_4$, or $8 \times 5°$ higher than œnanthylic acid, $C_{14}H_{14}O_4$; cinnamate of ethyl, $C_{22}H_{12}O_4$, boils $10 \times 14°{\cdot}5$ higher than butyrate of ethyl, $C_{12}H_{12}O_4$, or $10 \times 5°$ higher than pelargonate of ethyl, $C_{22}H_{22}O_4$.

The author compares the boiling-points thus calculated for five alcohols, $C_nH_mO_4$; for six acids, $C_nH_mO_4$; and for sixteen compound ethers, $C_nH_mO_4$, with the results of observation. In almost all cases the concordance is sufficient.

The author demonstrates in the next place that in many series of compounds other than those hitherto considered, the elementary difference, xC_2H_2, likewise involves a difference of $x \times 19°$ in the boiling-point. He further shows that on comparing the boiling-points of the corresponding terms in the several series of homologous substances hitherto considered, many other constant differences in boiling-point are found to correspond to certain differences in composition. Thus a monobasic acid is found to boil 44° higher than its ethyl compound, and 63° higher than its methyl compound, and this constant relation holds good even for acids other than those previously examined, *e. g.* for the substitution products of acetic acid. Also in substances which are not acids, the substitution of C_4H_5 or C_2H_3 for H, occasionally involves a depression of the boiling-points respectively of 44° and 63°; the relation, however, is by no means generally observed.

The author, in addition to the examples previously quoted, shows that compounds containing benzoyl ($C_{14}H_5O_2$) and benzyl ($C_{14}H_7$) boil 78° ($=4 \times 14°{\cdot}5 + 4 \times 5$) higher than the corresponding terms containing valeryl ($C_{10}H_9O_2$) and amyl ($C_{10}H_{11}$), a relation, however, which is likewise not generally met with. He discusses, moreover, other coincidences and differences of boiling points of compounds differing in a like manner in composition. Not in all homologous series does the elementary difference xC_2H_2 involve a difference of $x \times 19°$ in boiling-point. The author shows that this difference is greater for the hydrocarbons, C_nH_{n-6} and C_nH_{n+2}; for the acetones and aldehydes, $C_nH_nO_2$; for the so-called simple and mixed ethers, $C_nH_{n+2}O_2$; for the chlorides, bromides, and iodides of the alcohol radicals, C_nH_{n+1}, and for several other groups; that it is, on the contrary, smaller for the anhydrides of monobasic acids, $C_nH_{n-2}O_6$;

for the ethers, $C_nH_{n-4}O_8$ (which may be formed either by the action of one molecule of a dibasic acid, $C_nH_{n-2}O_8$, upon two molecules of a monatomic alcohol, $C_nH_{n+2}O_2$, or by the action of two molecules of a monobasic acid, $C_nH_nO_4$, upon one molecule of a diatomic alcohol, $CH_{n+2}O_4$), and several other series.

The author thinks that the unequal differences in boiling-points corresponding in different homologous series to the elementary difference xC_2H_2, are probably regulated by a more general law, which will be found when the boiling-points of many substances shall have been determined under pressures differing from those of the atmosphere.

"From the observations at present at our disposal, it may be affirmed, as a general rule, that in homologous compounds belonging to the same series the differences in boiling-points are proportional to the differences in the formulæ. Exceptions obtain only in cases when terms of a particular group are rather difficult to prepare, or when the substances boil at a very high temperature, at which the observations now at our command are for the most part uncertain. Again, it may be affirmed that the difference in boiling points, corresponding to the elementary difference C_2H_2, is in a great many series = 19°; in some series greater, in some series less."

The author proceeds to discuss the boiling points of isomeric compounds. He shows that in a great many cases isomeric compounds belonging to the same type, and exhibiting the same chemical character, boil at the same temperature, and that there is no reason why, for the class of bodies mentioned, this coincidence should not obtain generally. On the other hand, different boiling-points are observed in isomeric compounds possessing a different chemical character, although belonging to the same type (*e. g.* acids and compound ethers, $C_nH_nO_4$; alcohols and ethers, $C_nH_{n+2}O_2$), and in isomeric compounds belonging to different types (*e. g.* allylic alcohol and acetone).

The author shows that the determination of the boiling-point of a substance, together with an inquiry into the compounds serially allied with it by their boiling-points, constitutes a valuable means of fixing the character of the substance, the type to which it belongs, and the series of homologous bodies of which it is a term. He quotes as an illustration eugenic acid. The boiling-point of this acid, $C_{20}H_{12}O_4$, is 150°, and on comparing this boiling point with the boiling-points of benzoic acid, $C_{14}H_8O_4$ (boiling-point 253°), and of hydride of salicyl, $C_{14}H_8O_4$ (boiling-point 196°), it is obvious that eugenic acid cannot be homologous to benzoic acid, whilst, on the other hand, it becomes extremely probable that it is homologous to hydride of salicyl, and consequently that it belongs rather to the aldehydes than to the acids proper.

The author, in conclusion, calls attention to the importance of considering the chemical character in comparing the boiling-points of the volatile organic bases, and shows the necessity of distinguishing between the primary, secondary, and tertiary monamines, in order to exhibit constant differences of boiling-point for this class of substances. He discusses the boiling points of the several bases, $C_nH_{n-5}N$ and $C_nH_{n+3}N$, and points out how in many cases the particular class to which a base belongs may be ascertained by the determination of the boiling point.

The comprehensive recognition of definite relations between composition and boiling-point is for the present chiefly limited to organic compounds. But for the majority of these compounds, and indeed for the most important ones, this relation assumes the form of a simple law, which, more especially for the monatomic alcohols, $C_nH_{n+2}O_2$, for the monobasic acids, $C_nH_nO_4$, and for the compound ethers generated by the union of the two previous classes, is proved in the most general manner, so much so, indeed, that in many cases the determination of the boiling-point furnishes most material assistance in fixing the true position and character of a compound.

The author points out more especially that the simplest and most comprehensive relations have been recognised for those classes of organic compounds which have been longest known and most accurately investigated, and that even for those classes the generality and simplicity of the relation, on account of numerous boiling-points incorrectly observed at an earlier date, appeared in the commencement doubtful, and could be more fully acknowledged only after a considerable number of new determinations. Thus he considers himself justified in hoping that also in other classes of compounds, in which simple and comprehensive relations have not hitherto been traced, these relations will become perceptible as soon as the verification of the boiling-points of terms already known, and the examination of new terms, shall have laid a broader foundation for our conclusions.—*Proceedings of the Royal Society.*

TECHNICAL CHEMISTRY.

On the Preparation of Artificial Colouring Matters with the Products Extracted from Coal Tar, by M. E. Kopp.[1]

The dry distillation of organic matters, whether vegetable or animal, from the great variety of products to which it gives rise, constitutes one of the most interesting operations of chemistry. The reactions to which these products owe their origin are very complex, and some of them have been but little studied, as indeed is the case with many of the substances formed. If the body submitted to dry distillation could be maintained during the operation under uniform conditions of desiccation, temperature and pressure, the reactions and the products would be much more simple. If, for example, wood be heated very slowly in close vessels, first to 100° C. then to 200°, 300°, and so on, there is at first disengaged almost pure water, then impure strong acetic acid, and afterwards a mixture of acetone and acetate of methylene; the maximum of charcoal is left as residue, and the least amount of tar and gas is produced, the latter consisting only of carbonic acid and carburetted hydrogen.

In practice, however, when wood is distilled in cylinders of iron heated from the outside, the heat only penetrates to the interior gradually. The outside layers are therefore the first decomposed; they at first lose water, then furnish pyroligneous acid and wood-spirit, at the same time giving off carbonic acid and a little carburetted hydrogen. The inner layers in turn are similarly decomposed; but the products as they are given off are brought into contact with the outer layer, already in a more advanced state of decomposition and at a much higher temperature, and hence new reactions take place and new products are formed. Thus, the vapour of water in contact with red hot charcoal is decomposed, and forms carbonic acid and hydrogen; a part of the carbonic acid is again decomposed by the red-hot carbon to form some carbonic oxide; a part of the nascent

[1] Abridged from the *Moniteur Scientifique*, t. ii, liv. 26.

hydrogen combines with carbon to form various hydrocarbons; one part of the acetic acid is decomposed by the high temperature to form acetone and carbonic acid; another part reacts on the wood-spirit and forms methylic acetate; a fraction of the wood-spirit and acetone are also decomposed, producing tarry matters, pyroxanthrine, oxyphenic acid, dumasine, &c. To these must be added the influence of certain nitrogenised bodies, and we can understand how all these compounds, successively formed under the most favourable circumstances for acting on one another, since they are in the nascent state, and exposed to a high temperature, may give rise to the formation of a great variety of very different compounds which will be set free either in that state of a permanent gas, or a condensable vapour, and leave fixed carbon as a residue. The same takes place whether wood, coal, bituminous schists, boghead coal, asphalte, peat, resin, oils or animal matters be distilled, but it is evident that the original composition of the material submitted to dry distillation must powerfully influence the nature and composition of the products. In those which like wood are rich in oxygen and poor in nitrogen, the pyrogenous products contain much acetic acid and but little ammonia, and consequently have an acid reaction; on the contrary the matters containing much nitrogen, and but little oxygen, like coal and animal matters, give rise to the formation of much ammonia, and the products have an alkaline reaction.

We intend in this article to confine our attention to the products obtained by the distillation and rectification of the coal tar from gas works. Considerable differences are noticed in the composition of the tar procured from different qualities of coal and schists, according to the rapidity which the distillation has been conducted. Some tars, for instance, contain but little benzole and much naphthaline; boghead tar is rich in paraffine; others contain a preponderating quantity of phenol and benzole.

Table of the Products obtained by the Distillation and Rectification of Coal Tar.

Solid Products.	Liquid Products.			Gaseous Products.
	Acids.	Neutral.	Bases.	
Carbon.	Rosolic.	Water.	Ammonia.	Hydrogen.
Naphthaline.	Brunolic.	Essence of tar.	Methylamine.	Carburetted hydrogen.
Paranaphthaline, or Anthracene.	Phenic, or Phenol.	Light oil of tar.	Ethylamine.	Bicarburetted hydrogen.
Paraffine.	Acetic.	Heavy oil of tar.	Aniline.	Various hydrocarbides.
Chrysene.	Butyric.	Benzole.	Quinoline.	Carbonic oxide.
Pyrene.		Toluole.	Picoline.	Sulphide of carbon.
		Cumole.	Toluidine.	Carbonic acid
		Cymole.	Lutidine.	Hydrosulphuric acid.
		Propyle.	Cumidine.	Hydrocyanic acid.
		Butyle.	Pyrrhol.	
		Amyle.	Petinine.	
		Caproyle.		
		Hexylene.		
		Heptylene.		

Whatever may be the composition of the different kinds of tar, they are all submitted to distillation in order to isolate the principles capable of industrial application. But first of all it is necessary to separate the tar, as far as possible, from the ammoniacal liquor which is found with it. For this purpose it is heated for some hours to 80° or 100° C. by which it is rendered more liquid, and then the water separates more easily. It is then allowed to cool very slowly, and the water is drawn off by a tap placed at the lower part of the boiler. A certain quantity of tar obstinately retains the water, constituting a buttery matter, which may be allowed to run away with the water, to be added afterwards to another quantity of tar, to be dehydrated by a fresh operation.

Experience seems to have demonstrated that the most simple process, that is to say, distillation over a naked fire at the ordinary pressure, is still the most practicable and advantageous. As the volatile products have but little latent heat, the height of the still should be somewhat less than the diameter; for the same reason the head must be carefully protected from cold, and it is well to furnish the inside with a circular gutter, in which the products condensed in the head may be collected and run into the refrigerator. By this means the products are prevented from flowing back into the boiling tar and being decomposed by coming in contact with the sides of the still, which, especially towards the end of the operation, become very hot.

In condensing the vapours it is necessary to observe certain precautions. At the beginning of the operation, when the lighter and more volatile oils are passing, the worm must be well cooled to make quite sure of the condensation. Later, when the heavier and less volatile products are coming over, the water in the refrigerator may be allowed to get heated to 30° or 40°, and at last when the matters capable of solidifying, such as naphthaline and paraffine, pass, the temperature of the refrigerator should never be under 40°, and it may be allowed without inconvenience to rise to 60° or 70°. At this temperature the products condense perfectly, but remain liquid and run with ease. If the refrigerator were kept quite cold during the whole process, it might happen towards the end that the condensing tube would become blocked up by the solidified products, and a dangerous explosion might ensue.

At the beginning of the distillation the tar should not be allowed to boil too fast. Some distillers at this period pass a current of steam at 110° or 120° through the tar, to assist the disengagement of the more volatile oils. These in condensing form a limpid very fluid liquid, having the density ·780, which gradually rises to ·850; the mean density of all the products united is about ·830. It is this which constitutes the benzine of commerce. It contains a great variety of compounds whose boiling points range from 60° to 200°. They belong principally to the following series:—Cn Hn *e.g.* Amylene C_5H_5; Hexylene (Oleene, Caproylene), C_6H_6; Heptylene (Oenenthylene), C_7H_7, &c. CnHn+2 *e.g.* Propyle $C_{12}H_{14}$; Butyle, $C_{16}H_{18}$; Amyle, $C_{20}H_{22}$, &c. CnHn−6 *e.g.* Benzine, $C_{12}H_6$, &c.

When the density of the products exceeds 850°, the current of steam is stopped and the heat is increased. As soon as the temperature of the tar has risen to 200°—220°, the distillation recommences, and the oil condensed is found to have the sp. gr. ·860—·900, the mean being from ·880 to ·885. This product constitutes the heavy oil of tar, and contains phenol, creosote, and aniline.

Lastly, the ultimate products of the distillation, which on cooling become a buttery mass (or crystalline, if they contain much naphthaline), are set aside for the preparation of paraffine. They are placed in vats, which are cooled, in order that the solid matters may separate by crystallisation.

According to Payen, 2000 parts of rough oil or tar obtained by the distillation of Boghead coal furnish on rectification:—

1208	parts light oil,	density = ·825
200	„ heavy oil,	„ = ·860
400	„ pitch.	

The loss of 200 parts represents the gases, and the vapours and oils which have escaped. 2900 parts of

tar from gas works using Boghead coal, distilled in a similar manner, yielded :—

Water, slightly ammoniacal . . .		168	parts.
Light hydrocarbons, mean density .	·820	480	„
Heavy hydrocarbons „ .	·863	883	„
Fatty pitch, solid when cold, liquid at 150°		1195	„
Loss 6 per cent.		174	„
		2900	

(To be continued.)

On the Manufacture and Application of India-rubber for insulating Telegraph Conductors, by W. Hall.

The subject of telegraphy is now occupying the attention of Europe and America, consequent upon the progress made in connection with the science in question, which has proved itself so strikingly useful as well as beneficial to all civilised nations. In presuming to address such an audience as the present, I feel assured that my crude remarks will be accepted in that spirit of indulgence so characteristic of the scientific gentlemen to whom this paper is presented. In my treatment of the subject I shall endeavour, therefore, as clearly as I can, to detail a few facts and figures in connection with the subject of the present paper.

Gum caoutchouc is imported into this country in various forms. The Para rubber, which is of a superior quality, is generally sent in the shape termed bottle rubber; and is the best of the kind adapted for manufacturing purposes. It also is sent in the shape of a tube, in order to prevent waste in the process of cutting it into strips or threads.

Of the plants that yield commercial caoutchouc, the most important are the following, according to Dr. Lindley, viz. *Siphonica elastica, Hancomica speciosa, Ficus elastica*, and many others. Professor Faraday says that no appearance of texture can be observed in the pure transparent caoutchouc; it resembles exactly a piece of clear strong jelly. All the phenomena dependent upon its elasticity, which are known to belong to common caoutchouc, are well exhibited by it. When very much extended it assumes a beautiful pearly or fibrous appearance, and when doubled several times until further extension in the same direction is difficult, it is found to possess great strength. Its specific gravity is 0·925, and is a non-conductor of electricity. The pure caoutchouc has a very adhesive surface; its fresh-cut surfaces, pressed together, also adhere with a force equal to that of any other part of the piece.

I will now make a few remarks upon gutta-percha. This substance was introduced into this country by Dr. Montgomery, through the Society of Arts, in 1843. Dr. Montgomery's mode of treating it was as follows:—"The gutta-percha, when dipped into water nearly boiling, can be readily united, and becomes quite plastic, so as to be formed, before it cools to 130° or 140°, into any required form, which it retains at any temperature below 110°. We take as much of it as is necessary, and throw it into hot water, when it soon softens, and becomes as plastic as putty, and can then be moulded as required." This substance, however, has been extensively used for covering telegraph conductors, in consequence of its easy application and moderate insulating properties. I think I may state, without fear of contradiction, that india-rubber is by far a better insulator, and gives better results as to its electrical qualities than gutta-percha. I shall therefore confine myself in my remarks to the mode of applying india-rubber for insulating telegraph conductors, in preference to gutta-percha or any of its compounds.

The method used in covering telegraph conductors with gutta-percha is so simple a process that no explanation is necessary upon the present occasion, as most scientific gentlemen are well acquainted with the method adopted.

I will now describe, as briefly as possible, the application of india-rubber to insulating [illegible] prior to gutta-percha being used for that purpose. The method adopted was as follows:—The wire being first covered with cotton, was then varnished over with shellac and covered with one thin strip of manufactured rubber. Preparatory to using the latter, one side of the strip was coated with dissolved india-rubber, or any of the known solvents, so as to render the rubber homogeneous and waterproof, and I believe that if these cores have not generally been brought into use for telegraphic communication, it has been owing to the circumstance that they have been imperfectly constructed, and therefore not suitable for that particular purpose.

In the meantime gutta-percha has been so used, and it is a well authenticated fact that the greater part of our cables made from it have failed.

Now, having had twenty-eight years' practical experience in the manufacture and application of india-rubber and gutta-percha to the various purposes for which they are used, I felt assured that some great improvement might be made in insulating conductors with the before-mentioned gum, and I commenced first by covering the wire with the best cotton fibre, and then covered the cotton with strips of pure rubber, cut from the bottle, or any other form as imported. These strips were laid on spirally, and with overlap. I then wound round, in an extended form outside the spiral lappings of rubber, a thread of vulcanised india-rubber, covered with cotton or otherwise, and finally coated the latter with yarn saturated with best Stockholm tar. The whole of these operations were performed at one and the same time by a machine especially adapted for that purpose. In addition to the former process, I then submitted the core to a dry temperature of 120° or 130°, in order to render the lappings of rubber homogeneous and waterproof. I should, however, remark, that it requires care and practical experience in reference to the temperature which it is necessary to employ, so as to ensure a perfect core without destroying the properties of the india-rubber. I may state also that these cores, if properly constructed, will withstand nearly any amount of hydraulic pressure, thus rendering them particularly adapted for submarine cables, or any other telegraphic purposes.

Hitherto, telegraphic conductors have been insulated with gutta-percha, but, nevertheless, it has been found that when it is immersed in the sea, laid in the earth, or subjected to atmospheric influence, in fact to any change of temperature, its electrical conditions will be materially affected, so that in a short time it is partially destroyed, rendering it nearly useless for submarine cables.

It is an established fact that, when gutta-percha was first introduced into this country, about sixteen or seventeen years since, it was of a superior quality, but at the present time it is found to be of a very inferior kind, and it is obvious that this is one cause of its failure for telegraphic purposes.

Now, in the manufacture and application of gutta-percha for telegraph cores, there are many difficulties to

overcome, viz. to cleanse it from all impurities, to keep it free from moisture and the accumulation of air cells, during the process of its application to the conducting wire or wires; also the uncertainty of the conducting wire being in the centre of the core. I am of opinion, also that gutta-percha has not sufficient affinity when incorporated with india-rubber and shell-lac that would improve its insulating properties so as to render it a perfect insulating medium, which is so essential for submarine cables. I think, therefore, that nearly all the failures in telegraph cables, &c. are attributable to the inferior quality of the gutta-percha, as well as to the attempt to improve it by the introduction of foreign substances, which no doubt make it still worse. This is apparent to any one who has taken pains to investigate the causes of so many failures that have taken place within the last few years.

I have before stated that india-rubber was used for telegraph purposes before gutta-percha. The cause of its failure in the first instance was in consequence of the parties not being thoroughly conversant with its manufacture and method of application; the result was, that the properties of the india-rubber were destroyed by the artificial means used in order to render the rubber homogeneous and waterproof.

I have seen wires which were covered with india-rubber, nearly upon the same principle, namely, by immersing the rubber cores in hot water, in order to render the lappings of rubber homogeneous, and, as a necessary consequence, the caoutchouc becomes black, and has a very strong tendency to decompose; in fact, the solvent used does not evaporate when the rubber is submitted to such a mode of treatment. Moreover, the copper wire conducting heat much more rapidly than the rubber, tends to induce decomposition; still, the insulation may be perfect, although I am of opinion that cores constructed in the manner just described can last only for a short length of time.

There are some parties who contend that neither cotton nor fibre should be used in covering the conducting wire, previous to coating it with india-rubber or gutta-percha; and there are also others who who think it of practical utility. I must confess that I belong to the latter class. The reasons I adduce are as follows:—First, that no conducting wire should come in direct contact with the insulating agent, whether it be gutta-percha, india-rubber, or any other agent. Now, if cotton fibre or raw silk is used, no chemical action is likely to take place between the conducting wire and insulating medium; on the contrary it might possibly destroy its insulating properties. Again, the use of cotton fibre gives pliability to a core, and prevents the conducting wire from protruding through the insulating medium in the event of the core becoming twisted or bent, during the process of its manufacture into a cable, or from it becoming coiled; it also obviates the danger of a similar occurrence when the cable is being run out from the vessel at sea. If a gutta-percha, or any hard compound core, is bent backwards and forwards, the conducting wire does not recover its original condition of adhesion to the gutta-percha, as hitherto made. I am of opinion, therefore, that it is of the greatest importance to closely cover the wire with the best quality of cotton fibre, or raw silk, previous to coating it with india-rubber, &c. in order to ensure a durable and perfect insulating medium for submarine cables or subterranean conductors.—*Abstract of Paper read at the British Association.*

PHARMACY, TOXICOLOGY, &c.

On Unguentum Zinci, by Julius Schweitzer, *Practical and Analytical Chemist.*

Turner's cerate, an old and popular remedy, maintained a high name for a number of years, and only lost some of its reputation through the influence of a new and spurious article sold in its stead. The mineral base of this ointment is, as we all know, a native carbonate of zinc, called calamine. When the commercial value of this zinc ore became more generally known, very little of it found its way to the druggist who, regardless of its percentage of zinc, looked principally to its external appearance and colour, qualities entirely dependent upon casual impurities. For this reason rich but dull looking ores were usually refused, and far inferior but brighter looking specimens selected by preference. This very soon led to the substitution of minerals which, although found in the same mine, often contained not a particle of zinc, consisting principally of sulphate of baryta, iron, and silica. It is but natural that ointments made with such compounds could not produce the same beneficial effect as the old ceratum calaminare of Dr. Turner. A careful investigation led to the discovery of the substitution of sulphate of baryta for oxide of zinc, and drew the attention of medical men and chemists to select the artificially prepared oxide of zinc as a purer and more reliable substitute for the uncertain natural ore. The oxide made according to the then existing Pharmacopœia was a fine, white, light powder, which however when used for the preparation of the ointment did not give the expected satisfaction, and it was soon ascertained that the manufactured article, instead of being a pure oxide, was a basic hydrated sulphate. The chemical process for the preparation of the oxide of zinc was altered, but only with partial success; in removing the sulphuric acid it simply substituted carbonic acid. This hydrated basic carbonate of zinc kept its place till the Pharmacopœia of 1836 published a process which produces a pure anhydrous oxide, differing from all the former compounds sold under this name by its greater density, slight buff colour, and far greater purity.

Medical men and the public, accustomed to perfect whiteness in this preparation, and colour being generally a sign of impurity, mostly objected to this dense and slightly coloured oxide, and as, moreover, the greatest consumption for oxide of zinc is in the arts, for paints, where purity of colour is evidently the greatest desideratum, the demand for the old white oxide was therefore generally kept up, and manufacturers saw themselves obliged to continue the preparation of the better looking but impure article. Through the continued exertion of the Pharmaceutical Society, and Prof. Redwood in particular, who made this subject his especial study, and to whom we owe most of the above stated facts, the attention of chemists and the public in general was repeatedly directed to the inferiority of this enticing white oxide, which for paint as well as for healing purposes proved a continual source of complaint and failure. Efforts were now and then made to remedy these evils, and to prepare an anhydrous, pure, white oxide by direct oxidation of the metal at a high temperature. Such processes, however, only partly succeeded, as the volatilised oxide usually carried particles of the metal with it, which it became impossible to separate afterwards. Mr. Hubbuck, a manufacturer of white lead and similar pigments, at last succeeded in preparing in this way, by a peculiar contrivance and

on a large scale, a most beautiful and pure oxide of zinc, which in whiteness, uniform lightness, and purity fairly surpasses all former productions of this sort, and seemingly all difficulties and objections were satisfactorily overcome.

Fats and oils when in contact or mixed with metallic oxides soon turn rancid, a circumstance which gave dispensing chemists a great deal of trouble with seemingly quite simple and unimportant articles of their stock, namely, a few ointments, amongst which the unguentum zinci, the most delicate and nicest looking, may well be said to be the principal one. All animal substances will only keep good for a limited space of time, and such preparations as pomatums and ointments, may fairly be said to be subject to certain deterioration by age; nevertheless it was a well observed fact that some of the French pomatums retained their original sweetness for an almost unlimited space of time, the cause of which was long a mystery desirable to be ascertained. At last it became known that this property was due to an addition of gum benzoin, or benzoic acid, a proceeding which in one instance we had already adopted. In the preparation of those singular looking little bottles of pomatum known under the name of "pomade divine" amongst a host of other ingredients, we are directed to digest gum benzoin with the fat at a gentle heat for about forty-eight hours. But it was left to the late Mr. Bell to draw our attention particularly to the preservative property of the gum benjamin, of which he proposed to avail himself in the preparation of an unguentum zinci benzoatum. This proposition was eagerly accepted, and medical men and chemists will still remember Mr. Bell by this one of his last improvements in pharmaceutical chemistry—the unguentum zinci benzoatum.

This ointment is made by selecting the best and most fragrant gum benzoin, the so called benzoin in tears; this, when comminuted, is added to good fresh lard, in the proportion of ten grains to the ounce, and the whole digested in a water bath for about forty-eight hours; this subsequently strained is used for the preparation of the benzoated zinc ointment.

In making this ointment with two oxides of zinc, a difference of reaction will be observed between the oxide made by combustion and that made according to the Pharmacopœia, which slight as it may be, deserves nevertheless some attention. The buff coloured oxide of the Pharmacopœia seems readily and speedily to amalgamate with the benzoated lard, so much so as sometimes to impart to the whole still warm fluid a certain consistency, which in far greater degree becomes more observable when the ointment is cold. Subsequent experiments showed that the seemingly lighter oxide of combustion resists with greater effect the influence of weaker acids, while the dense oxide of the Pharmacopœia is readily dissolved by them.

This chemical difference is in all probability the cause of the different behaviour of these two oxides when used for the ungentum zinci benzoatum. Benzoic acid is readily dissolved by fats and oils, and in digesting the gum for some time with the lard, this acid as well as the aromatic principles impregnate the fat, and subsequently act on the zinc. How far this greater susceptibility to weak acids may be by itself a beneficial application to a wound is a surgical question, but it is a well known fact that many of the most skilful and eminent surgeons always prefer the buff coloured zinc ointment to the perfectly white one made with the new oxide of zinc of combustion.

The above remarks were accidentally elicited in conversation with Erasmus Wilson, Esq. F.R.S. &c. who drew my attention to the therapeutical action of this and other ointments. I cannot do better than quote some of his ideas from page 72 of his work on Skin Diseases, where, speaking on this subject, he says, "When first I commenced the treatment of diseases of the skin, water-dressing had just been introduced, and suddenly become the surgical fashion of the day, while a general outcry was raised against ointments, 'greasy applications,' as they were contemptuously called. Finding that in practice it was impossible to contrive any substitute for ointments in the treatment of these diseases, and being unable to discover any cause for the objections raised against them by my contemporaries, I set myself to inquire into the possible reasons of their disrepute. This was soon ascertained; they were ill-prepared, long kept, and in many instances so rancid as to act as irritants and aggravators of the disease. On the other hand, when properly prepared and perfectly fresh, ointments are all that can be desired as local applications. Again, it is to be remembered that a cutaneous eruption, by virtue of the inflammatory congestion which exists, is an actively oxidising surface, and ointments perfectly fresh when applied, are apt, by absorption of oxygen, to pass quickly into a state of rancidity. Hence we have not only to regard the purity of the ointment in itself, but also its tendency, when applied to the inflamed skin, to develope those acids of decomposition which constitute the rancid state. Thus the same ointment, according to its state of freshness or otherwise, may be a soother, or an irritant of the most mischievous kind, when applied to the skin. The power of gum benjamin in preventing decomposition in ointments is an important discovery, and is now pretty generally adopted by our London chemists. This gum, in a state of powder, added to the melted lard in the proportion of ten grains to the ounce, the ointment being subsequently filtered through paper, not only serves to preserve the ointment for a much longer time than it would otherwise remain fresh, but also gives it an agreeable odour, a condition of some importance where an application is required to be kept on the skin during the period required for cure. The benzoated oxide of zinc ointment properly prepared is the most perfect local application for all chronic inflammations of the skin that is known. It is cleanly and agreeable, of a cream white colour, not diffluent and oily like other ointments; and it has a tendency to concrete upon the skin, and constitute an artificial cuticle to an irritated and denuded surface." The mere mechanical influence, however, which he attributes to the oxide of zinc as an ointment, in simply rendering the fat firmer and more coherent, and so enabling it to form a more effectual film over the diseased part, and to prevent the injurious access and influence of the air, induced him to try oxide of magnesium instead of zinc, and his experiments led him to the belief that in many instances such an application will even be preferable to the stronger metallic unguentum zinci.

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Arsenic in a Drinking Water.—Note on the Arsenical Water of Whitbeck, Cumberland, by ARTHUR H. CHURCH, *F.C.S.*

THE recent reliable accounts of arsenic eating in Styria, the controversy as to the effect on the Thames water of arsenical perchloride of iron, and the detection of arsenic in numerous mineral waters and deposits invite special notice to the occurrence of this element. And now that

the influence on the animal economy of arsenic in minute but repeated doses is attracting so much attention, I think that the following account, incomplete as it at present is, of an arsenical drinking water will prove interesting. My attention was first directed to the subject by the Rev. Mr. Wilkin, of Booth, to whom, as well as to the Rev. Mr. Ormandy, of Whitbeck, and Dr. Fidler, of Whitehaven, I am indebted for much information and assistance.

From the northern and western sides of Black Combe, a mountain in the southern part of Cumberland, situated near the sea, numerous streams or *becks* originate; I believe that one only of these exhibits any marked peculiarity. Whitbeck, such is the name of this stream, is fed by several small springs, and it was from the source of the most southerly of these where it rises from the ground, and at an elevation of about 900 feet from the sea, that I obtained a specimen of the water for examination.

On the 29th of June in the present year, the water, at the time of collection, had a temperature of 8° 5′ C. the air being 10° 6′. The reaction of the water as it issues from the earth was faintly but unmistakably alkaline: on testing the water after ebullition the effect was more decided. The water from many other sources in the neighbourhood of Whitbeck, where decomposing granite is of common occurrence, has an alkaline reaction. A large and deep pool in the course of Whitbeck towards the sea shows the colour of the water to be a rich clear greenish blue.

The water, on examination, gave distinct indications of the presence of arsenic. This element, which here probably exists as an alkaline arsenite, occurs not as a mere trace, but in determinable quantity. I have not yet ascertained the amount present, but hope to do so shortly, when I have obtained specimens of the water collected at different seasons of the year. I have satisfied myself, however, that in some seasons of the year the quantity present approaches a good fraction of a grain of arsenic (metallic) in each gallon of water. At the same time I am desirous of furnishing complete analyses of some interesting minerals obtained from the vicinity of the spring. For on ascending the gulley, a few yards above the source of Whitbeck, we arrive at the entrance to a mine, which, some years ago, was worked for cobalt and copper, and is now again being searched. Here I obtained very rich and massive silver-white arsenical cobalt ore, and also copper pyrites. The neighbourhood for some miles is in fact rich in minerals. Dr. Fidler writes: "Almost immediately behind Whitehaven Parsonage a sulphur vein crops out, a continuation of the same vein that is being worked at Under Hill, but whether it exists in any quantity I do not know. There are three or four copper veins in a ravine behind Whitehaven Mill, one of which has been tried some twelve or fifteen fathoms below the surface." Baryta, also, has been found I am told, above the source of Whitbeck in the mine above-mentioned.

It will be seen that the arsenic in the water of Whitbeck is thus most probably derived from the veins of arsenical cobalt ore through which it percolates.

The arsenical water is *habitually used for every purpose* by the inhabitants of the little village of Whitbeck, and, as far as I can learn, with beneficial rather than injurious results. But it is remarkable that Whitbeck, though in every respect suitable for trout, is the only stream in the neighbourhood from which that fish is absent; eels, however, have been found in it. Ducks will not live if confined to this arsenical water. When the railway was being carried past Whitbeck, the first use of the water quickly produced the usual marked effect on the throats both of the men and horses employed on the works. The soreness of mouth from which they at first suffered soon however disappeared, and in the horses gave place to that sleekness of coat assigned as one of the effects produced by the administration of arsenic. It is a question how far the rosy looks of the Whitbeck children and the old age which a large proportion of the inhabitants of the village attains are to be attributed to the arsenic present in the water they drink.

The Antimony Poisonings at Liverpool.

Northern Circuit.—Liverpool, Aug. 20.—Crown Court. (Before Mr. Baron Martin.)

Thomas Winslow was this morning arraigned for the wilful murder of Ann James, the proprietor of an eating and lodging house in Vauxhall-road, Liverpool, with whom the prisoner lived as manager, &c.

Mr. Bliss, Q.C. (with whom were Mr. Aspinall and Mr. Temple) appeared for the prosecution; and Mr. Digby Seymour, Q.C., Mr. Fenwick, and Mr. Little for the defence.

In opening the case Mr. Bliss said that the prisoner was charged with the crime of wilful murder by means of antimony, which it was alleged he had administered in small and repeated doses. The deceased, Ann James, died on the 24th of June last, in the Liverpool Southern Hospital. She had been attended by Dr. Cameron at intervals from the preceding January. From the 6th or 7th of June until her death her excretions were preserved, and with one or two omissions were found on analysis to contain antimony, as did also the viscera and intestines, when examined after death. She died, however, of cancer of the cœcum, a natural disease, which had perforated the bowels and caused her immediate death, and the prisoner was accused of aggravating that disease by the administration of small doses of antimony, and so accelerating her death. She had been attacked before with repeated vomitings and purgings, the former coming on suddenly after taking food, and particularly sago, and then ceasing suddenly, and though she recovered, she manifested after such attacks extreme nervous prostration and muscular debility, which, with other symptoms, induced the medical man to believe that such administrations of antimony had hastened her death. If the jury were of opinion that the prisoner was the person who administered this antimony, and that he did it wilfully with the intention of taking life or doing grievous bodily harm, it would be their duty to find him guilty of murder.

The two first witnesses examined were the niece and nephew of the deceased, whose evidence was of no scientific interest.

Dr. Cameron was then examined by Mr. Bliss. He said he was a physician, lecturer on medical jurisprudence, and physician to the Liverpool Southern Hospital. The prisoner called on him in the Southern Hospital on the 5th of February, and requested him to visit Mrs. James. He did not know her, but he was acquainted with the prisoner, whom he had attended at the Southern Hospital. He found Mrs. James in bed, suffering from bowel complaint, and she had also a tumour in the abdomen, which he believed to be cancer. She was very weak and prostrated. Witness prescribed for her, and then desired them to send for him if she became worse. He was sent for on the 29th of March, when

the deceased's symptoms were similar to those he noticed when he first visited her. Again he found her labouring under violent purging and vomiting on the 8th of May, and this attack was much more severe than those previous. She was much improved, and in fact convalescent by the 19th of May—that was as regarded the purging and vomiting. He saw her again on the 25th of May, when she was very ill, and he suspected from the symptoms that some foreign ingredient had been administered. He suspected some irritating substance such as antimony had been given to the deceased. The deceased was convalescent again by the 6th of June. During his last visits he had prescribed an antidote to antimony. He found that the deceased was again very ill on the 8th and 9th of June, with the same bad symptoms, including extreme prostration. He obtained some of the deceased's urine on the 6th of June, which he gave to Dr. Edwards for analysis, and had been made acquainted with the result. On the 8th and 9th he also obtained excretions, and in consequence of the result of their analysis, he communicated with the police. He went with two police officers to the house of the deceased on Sunday the 10th of June. In the room of Mrs. James he saw some bottles of medicine and cups, and and one of the cups contained sago. The cups were given to Mr. Kehoe, of the detective police. Witness explained that Mrs. James was suffering from the effects of poison, and that it was necessary to have her removed to the hospital for her safety. At this time he also received some excretions, which Mrs. Cafferata had preserved by his order. He also gave orders that Mrs. James's excretions should be preserved. The deceased was very ill for some days after her admission to the hospital. She afterwards improved somewhat, till the 22nd, when she was seized with dangerous symptoms, and died on the 24th. I assisted at the *post mortem* examination. The body was greatly emaciated. The membrane of the gullet presented a yellow appearance. At the entrance of the stomach there were two patches of false membrane, but can form no opinion how these were caused. The stomach was distended and contained sixteen ounces of fluid. There were two small ulcers communicating with the cancerous tumours. These ulcers might have been caused by the administration of antimony or by disease. The bowels had been perforated and their contents discharged into the cavity of the abdomen, which was the immediate cause of death. I think in a case like that of Mrs. James, looking at all the symptoms and at the discovery of the antimonial deposits, it would have accelerated death. My opinion is that antimony was administered within a very short time of her admission to the hospital, some time between the 9th and 10th of June. I do not think antimony was given to her after her admission to the hospital. The vomiting of Mrs. James was not of the kind which the ulcers would produce, but was of a kind which might be produced by some irritating substance such as antimony.

In cross-examination by Mr. Seymour, the witness said that hot food in a case like that of Mrs. James might produce vomiting, and always occasioned more or less pain with ulceration of the stomach. There was no redness of the small intestines. Vomiting was one of the principle symptoms of ulceration of the stomach, as by tending to starve and weaken the patient it produced emaciation and prostration. Purging was not a usual symptom of an ulcerated stomach, but occurred with cancer in the bowels. Witness agreed with Dr. Richards as to there being no case in which slow antimonial poisoning was accompanied with dysenteric evacuations. The alternation of constipation and purging was one of the known symptoms of antimonial poisoning. The intermitting condition of the patient was one of the reasons which led to the conclusion that she was the subject of poison. Witness agreed with the opinion that in malignant diseases of the stomach the symptoms remitted in a remarkable manner, so as to excite a hope that recovery would take place; but the truce was not very long; frightful disorganisation was at length produced, and inevitable death at last. Softening of the brain had been noticed in some cases of antimonial poisoning, but it was not a frequent or even ordinary indication. Antimonial poisoning sometimes produced enlargement of the liver, but it did not in this case. Aphthous ulcerations in the glands of the small intestines are also symptoms of the presence of antimony; there were none in this case. Eminent writers on materia medica and pathology assert that some persons can tolerate the presence of poison in their bodies without it having any effect upon them. It is also an accepted truth among eminent scientific writers, that there are conditions and circumstances of the human frame in which antimony may not possess poisonous results.

On being re-examined, witness said—This toleration of poison is common in certain cases of inflammation, but it is my opinion that in this case the opposite to toleration has been established. Aphthous ulcerations are not often observed in cases of poisoning by antimony. The absence of these symptoms, combined with the state of the liver and brain, in no way affects my opinion as to the poisoning in this case. There were peculiar symptoms in the vomiting by Mrs. James, which induce me to believe that it was not caused by the ulcers. Antimony would aggravate the ulcerous disease, and enfeeble the bodily powers as well as affect the appetite. One of the effects of slow poisoning by repeated doses is that the stomach is prevented from receiving fresh nourishment.

To the Judge—I have never attended a human patient poisoned by antimony. Persons suffering from sickness after food are relieved by vomiting; but in the case of Mrs. James there was considerable retching after the food was thrown off the stomach.

The next witness, Wm. Horn, inspector of the Liverpool detective police, was examined by Mr. Aspinall—He said he accompanied Dr. Cameron to Mrs. James's house on the 10th of June, in company with Inspector Kehoe. In the deceased's room they found two cups on a table; one contained sago. He also took eight medicine bottles. He removed all these articles to the police court and sealed them up. They were then locked up by the storekeeper. He received back from the storekeeper two cups and one bottle, and gave them to Dr. Edwards.

Dr. Cameron having been recalled, identified his prescriptions, and said he gave tannic acid as an antidote to the antimony.

After some non-professional evidence witnesses were called who traced the secretions of the deceased to the possession of Dr. Edwards for analysation, and it was proved that the deceased, after her removal to the hospital, ceased to have attacks of vomiting after the first or second day of her admission.

Dr. John Baker Edwards, analytical chemist, examined.—He proved having analysed a bottle of urine he received on the 6th of June, and informed Dr. Cameron that he had found very slight traces of antimony in it. He had no doubt it was antimony. On Saturday, the 9th of June, he received two bottles from Dr. Cameron,

one of which contained fæces. He analysed it, and found in it slight traces of antimony. The other bottle contained vomit; he analysed that, and obtained two considerable deposits of antimony. He subsequently confirmed this analysis by other chemical tests. He sublimed it by the application of heat, and obtained a white sublimate, which, when examined under the microscope, had the appearance of oxide of antimony. He afterwards dissolved this in tartaric acid. He passed sulphuretted hydrogen gas through it and obtained an orange precipitate, sulphuret of antimony. He could not scientifically distinguish whether it was "free" or "eliminated" antimony. On the 15th of June he received a bottle of vomit. He obtained two considerable deposits of antimony from these, from which he obtained oxide of antimony, which he recognised under the microscope. The same day he obtained a bottle of fæces. He analysed that, and found a trace of antimony. The day after he received two bottles, one of urine, and found a trace of antimony in each. On the Wednesday he received three bottles, labelled "Mrs. James, Tuesday," one of which was labelled "vomit." It had scarcely a recognisable trace of antimony. The other two bottles contained fæces and urine, each containing a trace of antimony. On Wednesday, the 13th of June, he received two cups, one of them containing about a tablespoonful of sago. He analysed that sago, and obtained two considerable deposits of antimony on copper, which he sublimed, and recognised under the microscope as oxide of antimony. On Thursday, the 14th, he received three bottles, which he analysed; one of vomit, containing no antimony; the other two containing fæces and urine, each containing a trace of antimony. On the 15th of June he received three bottles, and in each he traced antimony. On the 15th and 16th he received bottles in the same way, and found traces of antimony. He also received some uncooked sago from Inspector Horn, in which he found no antimony. He subsequently received bottles labelled "Mrs. James." The vomit contained no antimony, the fæces and urine contained still distinct traces of antimony. He subsequently received four jars containing brain, lung, heart, spleen, kidneys, intestines, stomach, and blood, labelled "Mrs. James." He also received four bottles containing fluids. He analysed portions of these separately. He analysed one half of the stomach, and obtained five deposits of antimony. He also obtained five deposits of antimony from the intestines, four deposits of antimony from one of the kidneys, and three deposits of antimony from a portion of the liver. He found no trace in the brain. In four ounces of blood he found a distinct deposit of antimony. From the fluid of the stomach he obtained a deposit of antimony. He also analysed six bottles of medicine and two of wine, and found no antimony. On the 26th of July he took a portion of the spleen and lungs of Mrs. James to London, and examined them there in conjunction with Drs. Miller and Taylor, and also the deposits he had obtained from the viscera. He examined and tested them, and found by the most approved tests applied that they contained antimony.

Cross-examined.—The first satisfactory result he obtained was on the 9th of June. He had no doubt that the trace he found on the 7th of June was antimony, but it was not satisfactory. He had examined the body of a dog for antimony, which had been exhumed, and found not a trace. If the dog had vomited after taking it, he should not expect to find any.

Mr. Clarence Pemberton, house surgeon to the Southern Hospital in Liverpool, deposed that he attended Mrs. James and paid attention to her symptoms. He made the *p. m.* examination. Taking the symptoms observed during lifetime and the *p. m.* appearances, and assuming the judgment of Dr. Edwards to be correct, the cause of death, in his judgment, was the diseased cœcum; but the administration of antimony would undoubtedly accelerate her death.

Cross-examined.—Judging from what he saw in the hospital, all the symptoms might be attributed to natural disease.

By his Lordship.—In the *post mortem* examination he could find no traces or symptoms which he exclusively attributed to the administration of antimony.

Dr. Francis Ayrton examined.—He saw the viscera and other portions of the deceased sent for analysation. He observed some redness at the commencement of the small intestines. He observed some spots on the large intestines. He formed the opinion from those spots that an irritant had passed through the bowels. Antimony was an irritant, and would produce such appearances. He had heard the evidence given, and his opinion was that the deceased's death was accelerated by antimony.

Cross-examined.—What he observed in the viscera might be attributable to other causes than antimonial poison.

Dr. Alfred Swaine Taylor, examined.—He received some jars at Guy's Hospital from Inspector Horn, containing portions of the stomach, cœcum, liver, one kidney, and the heart. He afterwards received from Dr. Edwards a portion of the spleen and lungs. He divided them and delivered a part to Dr. Miller. He examined a part of the viscera and found antimony in the liver, spleen, and lungs, in conjunction with Dr. Miller. Dr. Edwards showed him some sublimates on glass and deposits on copper. He examined them. The deposits on copper were metallic antimony, and those on glass were oxide of antimony. He was of opinion that antimony had entered the body of deceased during life. He had heard the evidence given of the symptoms of the deceased and the appearances on the *post mortem* examination. Assuming the deceased to have been labouring under disease of the cœcum, and to have had two ulcers in her stomach, the administration of antimony to her, by depressing the bodily powers, would tend to accelerate death. Antimony has a powerful depressing influence, and lowers the pulse in strength, produces great exhaustion of the system, and that in a serious disease affecting the body was likely to aggravate its effects. A person might be able to bear a dose of antimony in health, who in serious disease would be destroyed by it. His opinion was in this case that antimony had been adminstered in small doses at intervals. Antimony might be found in the tissues for three weeks after it was taken. It might during that time be found in the secretions day by day, and at intervals. The tests he had applied for detecting antimony were the most approved known in science.

Cross-examined.—The disease which has been described as afflicting the deceased must have terminated fatally. The death of the deceased had been caused by inflammation arising from the passage of the contents of the diseased bowel into the cavity of the abdomen. It was very difficult to draw the line where a patient had rallied from the effects of poison and where she sank under disease. The medical man in attendance on the deceased person would be the best judge of the influence of the poison in accelerating death. Small doses, frequently repeated, would have the effect of irritating the mucous membrane of the bowels. In two most marked

cases of poisoning with which he had been connected there was no change in the condition of the liver. All the indications in the case of Mrs. James were referable to natural disease. If antimony were found in the fæces, he should conclude that the purging was occasioned by antimony. In vomiting caused by ulcers in the stomach it was confined to the relief of the stomach from its contents, and then ceased. Antimony produced prostration of nervous power.

Dr. Miller, professor of chemistry at King's College, corroborated the opinion of Dr. Taylor, so far as it related to the chemical analysis, but gave no medical opinion.

The prisoner was acquitted, but was immediately taken into custody again, and will be tried on other charges of poisoning.

NOTICES OF BOOKS, PATENTS, &c.

The Comparative Properties of Human and Animal Milks. A new Theory as to "Essences," and a new Interpretation of some Physiological Facts, &c. &c. by M. A. Baines. London: Churchill, 1860.

We took up this little work with much curiosity. Seeing how greatly ladies have distinguished themselves in literature, in the arts, in pure science, and in some of the natural sciences, we have often been surprised that we had never met with a female chemist, — not a mere book chemist, for there are some who may claim that distinction,—but one willing to submit to the tedium and desagrémens of the laboratory, in search of new facts, and as yet unapprehended truths. Here, we thought, on reading the promising title of this book, is such a lady, and one who has not only been busy in the accumulation of facts, but has acquired sufficient on which to found "a new theory." We therefore opened the book with great interest; truth, however, obliges us to confess our complete disappointment. We soon found that the questions raised concerned rather the physician and physiologist than the chemist; but still there are statements made which a chemist could not pass over without remark.

The question the authoress raises we must inform our readers is the following: What is the best food for an infant who is deprived, either by necessity or caprice, of its natural aliment? "The common idea is that one or other of the animal milks must afford the best substitute for breast milk;" but this idea is combated, on what are supposed to be chemical grounds, in the following terms: —

"By the results of chemical analysis we are given to understand that animal milks approach very nearly to human milk; that is to say, that in the properties of their various elements or constituent parts, all kinds of milk bear a close resemblance to each other. But medical inquirers have been too well satisfied in relying on the revelations thus afforded by chemistry, and have attempted to found a system of artificial feeding upon its imperfect teachings, 'imperfect,' because incomplete. The results of chemical experiment are of course reliable as far as they go, but analytical processes (in the present undeveloped condition of the higher ranges of chemical science) cannot throw sufficient light upon our subject, for there are subtleties which lie beyond. Chemistry, though affording valuable aids to the student in many departments of medical science, does not embrace all the truths which must be apprehended in order to arrive at a satisfactory solution of the present question.

"I come now to speak of those 'essences' in human milk which necessarily have an existence (at least for this I am contending), and must enter into the calculations of the scientific inquirer ere we can hope to establish any system of feeding infants with better success than now. The food of the human mother and that of the animal are of so distinctive a kind that the nutritive properties of the respective milks must be supposed to partake of that difference. When this idea shall be thoroughly understood, and this great fact of natural science shall be well recognised, then, and not till then, will the value of an admixture of vegetable substances be sufficiently appreciated as forming, with cow's milk, the proper food for infants."

Now, with regard to this "new theory of essences," it is clear that our authoress has picked up a metaphysical idea, and taken it for a chemical fact. It is no new theory, for metaphysicians in all ages have acknowledged a something which "constitutes the particular nature of a being or substance," and we shall not call its existence in question. All we can say is, that chemistry knows nothing of these essences, and though they may afford matter for much useless speculation and disputation, yet, inasmuch as they can never find their way into the test tube or the balance, they are altogether beyond a chemist's cognizance.

Our space will not allow us to enter on all the questions raised in the above quotation, nor, indeed, do they lie within our province. But we must stop to point out one or two small inconsistencies. We are quite willing to confess chemistry an incomplete science, and admit its "imperfect teachings," and yet how but by these imperfect teachings could the authoress have arrived at the conclusion that "an admixture of vegetable substances with cow's milk formed the most proper food for infants"? What but these analytical processes, for which she has so little respect, have made it known to her that "cow's milk has ten degrees less of combustible ingredients than human milk," and have taught her that there are "articles having a high figure of respiratory matter," with which accordingly she proposes "to supply that deficiency in cow's milk."

We say so much in defence of our science, which seems, after all, to have guided the writer to a very correct conclusion. Her system of feeding infants is no doubt a very good one—long experience, indeed, for there is nothing new in it, has proved it to be so—but we must not enter on this question. On turning to the conversation at the end of the book, we see that the medical gentlemen had little to say on the subject really proposed for discussion. There is one practical suggestion, however, by Dr. Routh, which may deserve some attention. He said "that the milk of the animal could be made very closely to resemble human milk by attention to the animal's food," and he proposed that "milch animals should be kept and fed for the purpose of affording milk to infants deserted by their mother."

If this were the place, we might venture a remark or two on some other matters alluded to in the paper, but here we are merely chemists, and have done. In all her benevolent exertions on behalf of infantine humanity the writer has our warmest sympathies, and we are only sorry that we have had to object to her chemistry.

CORRESPONDENCE.

Precautions against Accidental Poisoning.

To the Editor of the Chemical News.

Sir,—The "Hints" which appear in your impression of August 18th are excellent, because simple and practical; it is much to be hoped that the plan proposed will be adopted systematically by every chemist and druggist; if so, legislation in the matter, as regards them, would be unnecessary; but supposing every pharmaceutical chemist were to take the precautions prescribed, what, may I ask, could be done in the case of the numerous dealers in drugs? who, as "grocer druggists," or under whatever designation, would still be at liberty to sell poisons carelessly and indiscriminately with other articles of a miscellaneous character? Such *general shops* are usually to be found in villages and remote country towns, probably some good might result if a license were required to be taken out, by persons entering

into a business in which poison of any description formed a part. All members of the pharmaceutical body, in virtue of their *status*, might be exempt from such rule or regulation; but at all events the suggestions which I recently offered through the CHEMICAL NEWS would apply to any case of irregularity in which the vendor of poison had not taken proper precaution in selling a deadly drug.

I wish now to point out another source of danger not hitherto referred to, and a means for guarding against it. I refer to the custom of labelling bottles "*The mixture as before*" in cases where the medicine is ordered to be repeated; I will give an illustration in order to show the amount of inconvenience and of danger which this custom may cause.

We will suppose a family of three or four children suffering from scarlet fever, measles, or any of the ailments incidental to childhood: the little patients may be in various stages of the disorder, and each may require a distinct medicine given at different intervals.

The doctor orders the medicines to be continued, and a second bottle arrives for each child with the direction "to be taken as before."

Now this is imposing too severe a tax upon the memory of the most *intelligent* nurse (and that description is unfortunately rare) to expect that she will be quite up to her lesson on each occasion; her mind would most probably be in a hopeless state of confusion as to which little patients ought to take "a fourth part twice a day," or which a teaspoonful three or four times a day," or indeed which medicine should be given in the larger and which in the smaller dose.

Now, when it is remembered that cough mixtures in general contain opiates; and that arsenic and other active poisons, though in small quantities, have place in many medicines, it will be seen that an overdose of these might lead to most serious results.

I would advise therefore that when mixtures are to be repeated, they should invariably have the full, *i. e.* the *original* directions on the label.

The assistants in the surgeries of apothecaries are as much concerned in this matter as chemists.

I hope this hint may be deemed worthy a place in your columns in addition to those which have already appeared there.—I am, &c. PRO BONO PUBLICO.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Iodide of Antimony.—Schneider prepares iodide of antimony[1] by heating a mixture of one equivalent of sulphide of antimony and three equivalents of iodine. An orange sublimate in plates and needles is produced which does not appear to be homogeneous, but to which the formula SbI_3S_3 has been attributed by Henry and Garot.[2] At the same time there condense in the hottest parts of the retort large red plates of iodide of antimony, SbI_3. These are hexagonal tables identical in their form with those of the iodide of bismuth. They dissolve slowly in sulphide of carbon, and the iodide is again deposited from the solution in small well-formed hexagonal crystals. Alkalies and alkaline carbonates in solution remove the iodine from the iodide of antimony and leave pure oxide of antimony.

II. ORGANIC CHEMISTRY.

Solubility of Starch in Cold Water.—Whether or not starch, properly so called, is soluble in cold water, seems doubtful, but, at all events, when potato starch is triturated for a long time in a pestle and mortar, with a small quantity of water, or is rubbed for a shorter time with quartz-oze sand, and a little water, and then more water is added, a solution is obtained which gives an intense blue colour with iodine. Before the iodine is added, the mixture should be allowed to repose for 24 hours, and then the clear liquor should be decanted and filtered through Swedish paper. The solution so obtained is perfectly clear, and the microscope shows no trace of matter in a finely divided state. The starchy matter must therefore be perfectly dissolved. The blue colour produced when iodine is added disappears when the liquid is heated, and reappears on cooling. No deposit of iodide of starch is obtained on standing. Basic acetate of lead gives a voluminous white precipitate with the solution just as with solutions of gum; the neutral acetate does not. Baryta water gives a white precipitate. Fehling's cupro-potassic solution is reduced in the cold. Nitrate of protoxide of mercury, chloride of gold, perchloride of iron, and sulphate of copper, do not produce any precipitate. Delffs supposes that the matter dissolved must have the same composition as starch, $C_6H_5O_5$, or must be represented by a multiple of this formula, inasmuch as it may be found contained in the starch, properly so called, in variable quantity, without altering its composition. He thinks, further, that it serves for the formation of starch, which, like all organised bodies, grows by intussusception; it may arrive by endosmose to fill the starch cells, and there undergo an isomeric change which renders it insoluble, like the outer and older layers of the starch globules. For these reasons he proposes to call this soluble matter *amylogene*.

III. ANALYTICAL CHEMISTRY.

Estimation of Tin in Ores.—M. Moissenet publishes[3] a process for the estimation of tin in the form of a metallic button, by precipitating the metal from a solution of the chloride by means of zinc and then melting the precipitated metal in stearic acid. His process comprises five operations:

1. Purification of the ore by treatment with aqua regia.
2. Reduction of the residue in the presence of charcoal.
3. Solution of the tin and iron in hydrochloric acid.
4. Precipitation of the tin by means of zinc.
5. Fusion of the precipitate into a button in stearic acid.

The precipitation of tin by zinc is very rapid, and takes place in strongly acid solutions; but the amount of acid and the dilution of the chloride influence the condition of the precipitate. In some solutions it appears in brilliant needles, but in very dilute solutions, and always towards the end of an operation, it is only a muddy deposit. The author recommends that a button of zinc be suspended in the liquid by means of a copper wire. When the precipitation is finished the metal is collected and pressed into a porcelain capsule. The plate so formed is melted in a few minutes in the presence of a piece of stearine candle.

[1] *Pogg. Annal. der Physic u. Chem.* Bd. cix. s. 609.
[2] *Journ. de Pharm.* t. x. p. 511.

[3] *Comptes-Rendus*, t. li. p. 205.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Sulphur.—Pass sulphuretted hydrogen through the solution, collect and dry the precipitate and reduce with a mixture of nitrate of potash and carbonate of soda.

J. R.—Green, 62 Paternoster Row, lets out diagrams to illustrate occasional lectures.

W. W. asks if any of our readers can give him information on the working of amber.

T. R.—The analyst is to be paid a salary as well as the fees—or the payment of half a crown for an analysis would be absurd. The analyst must be guided to some extent by circumstances. Our correspondent's letter had no address.

Will the correspondent who asked a question about stannate of soda be kind enough to repeat his query. The letter has been mislaid.

Mr. *B. S. Proctor's* letter is in type. Received—*W. G.*

☞ Reading covers have been prepared for preserving the numbers of the CHEMICAL NEWS until bound. These may be had on application at our Office, or by order through any bookseller or newsman.

*** All *Editorial Communications* are to be addressed to MR. CROOKES, and *Advertisements* and *Business* communications to the PUBLISHERS, C. MITCHELL & Co. at the Office, 12 Red Lion, Court, Fleet Street, London. E. C.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Cespitine, and other Bases produced by the Destructive Distillation of Peat, by ARTHUR H. CHURCH *and* EDWARD OWEN.

As the investigation of the bases produced by the destructive distillation of matters of vegetable and animal origin becomes more thorough, so the great similarity, if not the identity of these products becomes more clearly apparent. It is indeed strange to find that a material such as coal, to which no definite formula can be assigned, should yield basic products centesimally, if not essentially, identical in composition with those derived from cinchonine, a pure substance of definite formula. It is thus scarcely possible to deduce from the results of the present investigation any conclusion as to the chemico-historical relations of peat and coal, for it would seem probable that the bases derived from animal substances such as gelatine and hair, those from the complex vegetable products shale, coal and peat, and from the pure alkaloids quinine, cinchonine, &c. will be found to be alike members of the methylamine, pyridine and chinoline series. The beautiful and singular liquid known as pyrrol generally if not invariably accompanies these bases; aniline and some of its homologues are also occasionally found here. Two remarkable and some exceptional results have however been obtained in our investigation of the bases from peat: we have ascertained the complete absence of aniline, and have determined by many experiments that the base from peat which has the composition of amylamine is isomeric but not identical with that substance, and is a nitryle. To this conclusion we were forced reluctantly, as will be seen further on.

The crude material which furnished the bases described in the present communication was obtained by the destructive distillation of Irish peat. The operation was performed in a blast-furnace, according to the patent of Mr. Rees Reece, the carbonaceous residues of former operations constituting the fuel employed. The distillation was conducted at the lowest possible temperature, avoiding thereby any undue carbonisation of the turf prior to the formation and liberation of its volatile products. Close to the nozzle or *tuyère* of the blast, the heat, it is true, is intense, but the carbonic acid there produced passing up the furnace through a zone of carbon, is reduced in temperature and converted into carbonic oxide, while this gas ascending higher carries off the tarry products of the turf at a temperature of some 200° C. only. The bases upon which we have been experimenting were contained in the distillate of a tar thus produced in the destructive distillation of peat in an atmosphere of carbonic oxide and marsh-gas at the lowest possible temperature. According to the researches of Kane and Sullivan, the tarry products from the various kinds of peat differ but very inconsiderably in their ultimate composition.

The process adopted in order to extract the bases from the peat distillate was essentially the same as that employed by Hofmann, and described by him in his papers on the organic bases contained in coal-gas naphtha. The oil, about 400 gallons, being the product from the distillation of 100 tons of peat, was shaken with hydrochloric acid, the solution drawn off, and this operation repeated until no more bases were thus extracted. The pyrrol and other impurities in the acid solution were then removed by long-continued ebullition, and evaporation to a small bulk. The liquid was then filtered, introduced into a still, and supersaturated with lime. The bases that came over on distillation were again combined with hydrochloric acid separated anew by distillation with excess of potash. They were then thoroughly dried with caustic potash, and submitted to repeated fractional distillations. The ammonia, the quantity of which yielded by peat is comparatively trifling, and any very volatile bases present had been previously eliminated in the original distillation of the peat, and occurred in the watery fluid which accompanied the oils.

Between 500 and 600 distillations were performed during the course of the present investigation, and the expenditure of material, time, and labour has been very large. We could have wished to offer an exhaustive account of the complex basic fluid which we have worked upon; the entire absence of any knowledge of the bases produced by the destructive distillation of peat must be our excuse for the imperfections of the present memoir.

A few tentative experiments were first made as to the nature and composition of the basic oils by means of their platinum salts. But our attention was soon mainly directed to the most volatile fraction collected between 95° and 97°, and the boiling-point of which was almost constant at 97°. This liquid was in reality separated by an interval of 23° from the next higher fraction, while any more volatile bases that might originally have been present in the distilled oil had been lost in the various operations to which it had been subjected. To this body, which subsequent examination proved to be a pure base, we have assigned the name *cespitine*. We proceed to detail our analyses and experiments, and to give some account of the properties of the new base and its derivatives.

Cespitine.—The fraction 95° to 100° of the 8th rectification was dried thoroughly with caustic potash and redistilled; the portion coming over between 95° and 97°, which constituted $\frac{1}{16}$ of the whole, being employed for experiment. A considerable quantity was dissolved in water, hydrochloric acid added, and then bichloride of platinum; sufficient water to redissolve the orange-yellow crystalline precipitate first formed was then poured in and the mixture set aside to crystallise. Several crops of magnificent orange-red shuttle-shaped crystals were successively obtained, and these, after

washing with alcohol and ether, gave on analysis numbers which furnished the following per centages:—

	Experiment.				Theory, $(C_{10}H_{13})'''$ $NCl,PtCl^2$.
Carbon	20·41	20·26.	.	.	20·43
Hydrogen	4·83	4·89	.	.	4·77
Nitrogen	...	...	.	.	4·77
Chlorine	...	...	.	36·36	36·29
Platinum	...	... 53·56	33·66	33·68	33·74[1]
					100·00

The platinum salt analysed had therefore the composition of that of amylamine; our reasons for thinking it isomeric, but not identical with that substance, will be found below. We place but little reliance upon any distinctions based upon the physical characteristics only of the two salts, such characteristics being singularly variable in the case of many platinum salts. A few brilliant yellow spangles finally separated from the mother-liquor of the cespitine platinum compound, and gave when burnt 34·50 per cent. of platinum. This agrees with the percentage of platinum in the pyridine double salt—34·68.

Our earliest determination of platinum in the platinum salt of the fraction 95°—100°, gave the following percentage: 33·29, 33·29, 33·86, and 34·19.

These numbers agree pretty closely with those required by the theory, $C_{10}H_{14}NCl,PtCl_2$, while the excess of platinum obtained in the two latter analyses, made with a salt recrystallised by the aid of heat, is probably to be explained by the result of an experiment in which we have proved that the cespitine platinum salt yields a platinised derivative when boiled with water. Before proceeding to describe this new substance, we give the percentages furnished by an analysis of the pure base cespitine.

	Experiment.			Theory, $C_{10}H_{12}N$.
Carbon	. .	68·81	. .	68·96
Hydrogen	. .	15·00	. .	14·95
Nitrogen	. .	...	. .	16·09
				100·00

The platinum salt of cespitine, which is but slightly soluble in cold water, dissolves readily in boiling water, and the solution, if kept in steady ebullition for half an hour, deposits brilliant pale yellow scales, the supernatant liquid becoming colourless.

During this transformation hydrochloric acid is evolved in considerable quantity, and may be readily detected at the mouth of the vessel. The reaction proceeds as follows:—

$$C_{10}H_{14}NCl,PtCl_2 = C_{10}H_{13}PtNCl_2' + HCl,$$

and is perfectly analogous to the change produced in the platinum salts of pyridine and picoline by ebullition with water, although it is effected with much greater ease, and its production is not preceded by that of a double compound containing one equivalent of the original united with one of the changed salt.

The compositions of the new crystals was ascertained by analysis.

	Experiment.			Theory $(C_{10}H_{13})'''PtNCl_2$.
Carbon	.	23·19	. .	23·34
Hydrogen	.	6·23	. .	5·06
Platinum	. 38·21 ..	38·11 ..	38·16 .	38·52
Nitrogen	. ...	...	... .	5·45
Chlorine	. ...	...	... .	27·63
				100·00

(*To be continued.*)

[1] 99 is the equivalent of platinum adopted.

On Numerical Relations existing between the Equivalent Numbers of Elementary Bodies, by M. Carey Lea.

(*Concluded from page* 111.)

It has been the object of this paper to develope as far as possible those numerical relations existing between the atomic weights of the elements which have not been previously observed. It is impossible in the present state of science to explain why such relations should exist, nevertheless nothing which tends to an exacter knowledge of the laws which govern the proportions in which the elements combine should be neglected.

The substances which compose the chlorine group form a well marked family to which fluorine seems also to belong. The analogies which unite chlorine, bromine, and iodine appear to multiply with each new investigation of their properties. We might therefore naturally look to find striking numerical correspondences between their atomic weights, but the analyses on which we at present rely give us numbers which afford no relations positively exact. Of the four numbers 19, 35·5, 80, 127 two are prime, one fractional, and one has many divisers. Such numbers are very unpromising for the development of numerical relations. Thus far, however, at least relations do exist: that it is possible to express the value of the equivalent of any one of these substances in terms of any two of the remaining—each equivalent is a function of any other two, thus:—

$$I = 10Cl - 12F$$
$$I = \frac{5Br - F}{3}$$
$$I = \frac{12Br - 2Cl}{7}$$

Similarly the author establishes like relations between all the members of the same group, a few examples of which we quote,—

$$Br = 6Cl - 7F$$
$$Cl = \frac{12Br - 7I}{2}$$
$$F = 5Br - 3I$$

If these equations, he continues, represented approximations no matter how close, they would not be worthy of consideration. They are perfectly exact. The quasi-connection of oxygen with this series will be pointed out further on.

It has been remarked that the atomic weights of the members of the oxygen series proper differ from each other by whole multiples of the atomic weight of oxygen; but the extent to which differences of this kind exist amongst the atomic weights of the elementary bodies has perhaps not been pointed out. The elements having the highest atomic weights are bismuth and gold; commencing with the first of these, and diminishing its atomic weight successively by whole multiples (in one case by a sub-multiple) we obtain the following series:—

208 Bismuth − 8 × 10 = 128 (Iodine = 127)
128 − 8 = 120 (Antimony = 120·3)
120 − 8 × 2 = 104 (Lead = 103·5)
104 − 8 = 96 (Osmium = 97)
96 − 8 × 2 = 80 (Bromine = 80)
80 − 4 = 76 (Arsenic = 75)
76 − 8 = 68 (Vanadium = 68·6 Barium = 68·6)
68 − 8 = 60 (Uranium = 60)
60 − 8 = 52 (Ruthenium = 52·2)
52 − 8 = 44 (Strontium = 43·77)
44 − 8 = 36 (Chlorine = 35·5)
36 − 8 × 2 = 20 (Calcium = 20 Fluorine = 19)
20 − 8 = 12 (Magnesium = 12)

Again, commencing with gold and diminishing by 8 or multiples of 8 (except in one case) we have the following succession. Gold (taken at 196), silver 108, mercury 100, tungsten 92, tellurium 64, cadmium 56, molybdenum 48, selenium 40, zinc 32, sulphur 16, oxygen 8. From tungsten 92 it is necessary to subtract $8 \times 3 + 4$, in order to reach tellurium 64. In all the other cases the number is found by subtracting 8 or a simple multiple.

Dumas has pointed out some beautiful and important relations by constructing a parallel series of numbers, which, by the subtraction of each term of the one from the corresponding term of the other, exhibit a constant difference within a certain degree of approximation.

The analogies pointed out in the several parts of this paper evidently lead directly to the construction of series of the same kind, some of which, together with others depending upon yet different relations, are given below:—

− Oxygen	= − 8	Chlorine	= 35·5	Bromine	= 80	Iodine	= 127
− Zinc	= − 32·6	Magnesia	= 12	Cadmium	= 56	Lead	= 103·5
	24·6		23·5		24		23·5

In connection with these two parallel series we may remark that oxygen appears to constitute a negative term in the chlorine series, precisely as nitrogen does in phosphorus, and zinc in the cadmium series, with considerable approximation to exactness. If the atomic weight of chlorine were taken at 36 instead of 35·5, it would constitute an exact numerical mean between the atomic weights of bromine and oxygen, supposing the latter to be taken with the negative sign. We have before seen that nitrogen, the negative member of the phosphorus series, is less closely allied with the rest than they are with others. Still greater is the step between chlorine and oxygen, so great indeed that it is very doubtful whether they can properly be classed in the same series, although certain cases of isomorphism can be urged in favour of such a classification.

It is not easy to fix the exact amount of importance which attaches to the numerical relations up to this time ascertained to exist between the atomic weights of the elements. Some are, no doubt, mere casual coincidences; and relations remarkably exact and symmetrical may exist between the atomic weights of bodies which have no analogies in their properties; for example, we may take calcium 20, selenium 40, uranium 60, bromine 80, mercury 100. Here the differences are not only exact, but all the subsequent members are multiples of the first, and this between bodies remarkably dissimilar in their properties—a striking proof of the necessity of caution in inferring relations of properties as following from relations of numbers. But, on the other hand, to reject the relations of number, when accompanied by analogy of properties as unmeaning and unimportant, would be to err quite as much on the other side. When the received equivalent of an element forming a term in a well marked series differs from that obtained by calculation it naturally leads, as Professor Mallet has remarked, to suspect an error and desire a re-determination. The fact that a group of elements allied in their chemical characters may be arranged in a series having a common difference or a definite ratio between its terms confirms the propriety of grouping those elements together, and such analogies in doubtful cases assist us in arriving at a correct classification.

TECHNICAL CHEMISTRY.

Means of Determining the Quality of Milk[1], *by Dr.* H. Minchin.

To determine with accuracy the quantities of the proper constituents of a given specimen of milk will, of course, require that it be submitted to a chemical analysis, for which purpose an expensive apparatus is necessary, while the process is of necessity both tedious and laborious, and not at all adapted to the requirements of ordinary cases, in which a daily examination must be made. It therefore became necessary that some more simple method should be devised of estimating approximatively the qualities of this fluid. The several modes of milk-testing which have been suggested are well known, the principal being—1st, the lactometer, or cream-test of Sir Joseph Banks; 2nd, the hydrometer, or specific gravity test; 3rd, the lactoscope of M. Donné; and 4th the microscope. It may be necessary to make a few remarks on the use of these several instruments, and first, of the lactometer. A glass tube of about eleven inches long, and half an inch in diameter, is filled with milk to within a short distance of the top, the surface of the fluid being made to coincide with a transverse line drawn on the tube, and marked zero; the capacity of the tube from this line downwards is divided into one hundred equal parts or degrees. When the tube thus filled has been suffered to remain undisturbed for a definite time, say twelve hours, or twenty-four hours, the quantity of cream which shall have separated spontaneously during that time is ascertained by an inspection of the instrument held in a proper light, as the inferior limit of the stratum of cream is generally defined with sufficient clearness to enable one to read off accurately the percentage of this ingredient which has become separated from the milk within the time specified. In using this instrument, it is necessary to observe certain precautions: the milk should be quite fresh, but the tube should not be filled till the milk has cooled down to the temperature of the place where it is destined to remain while at rest; the entire mass of milk should always be well stirred up immediately before the sample to be tested is taken out; the lactometer when filled should be left undisturbed for about twelve hours if the weather be warm, for twenty-four if it be cold. Milk which has been thus tested is said to show a certain percentage of cream, and the higher the number of degrees indicated by the lower edge of the cream stratum, the more of this ingredient is the milk supposed to possess. As far as this goes, nothing can be more simple and satisfactory, if it were only true, but it can be shown that the indications of the instrument in question are fallacious, and calculated to lead to the most erroneous conclusions, especially in the case of those milks in regard to which it is most important that the information supplied by this test should be as accurate as possible—for example, in those cases in which milk is supplied by contract in large quantities to public institutions. The fact is unquestionable that contractors are in the habit of supplying a liquor which they call milk, at a price so excessively low that they must either add a large proportion of water, or sustain a serious loss; and the managers of large institutions are often satisfied to accept this so-called milk at the price agreed upon, provided the lactometer shows a certain percentage of cream. In reference to the effect which the addition of water to milk exercises on the indications of the lactometer, Dr.

[1] Abstract of a Paper read before the Dublin Chemical Society.

Hassall, who has made the analysis of very numerous specimens of milk, makes the following remarks:—

"It is stated," he says, "that the addition of a small quantity of warm water to milk increases the amount of cream: the belief in the accuracy of this statement is entirely erroneous: the addition of water to milk does not increase the quantity of cream; it merely facilitates and hastens, in a most remarkable manner, its formation and separation, as is shown by what follows:—Six lactometers were filled, one with pure milk, the remainder with the same milk diluted respectively with 10, 20, 30, 40, and 50 percentages of water. In twenty minutes, the lactometer containing pure milk showed but half a degree of cream; in forty minutes it showed 4°; and at the end of twelve hours it showed 9°. The instrument containing 50 per cent. of water showed in twenty minutes 6° of cream; in forty minutes 6½°; and at the end of twelve hours 5°. The rapidity with which the cream was thrown up on the other four tubes—viz. those containing 10, 20, 30, and 40 percentage of water was proportionally great; the two extreme cases have been quoted merely in order to exhibit more prominently the results which were obtained." It thus appears, continues Dr. Hassall, "that the addition of a large quantity of water to milk occasions an almost immediate formation of cream, but does not augment the amount; of this fact, in some cases it would be an advantage to dairymen to avail themselves. The addition of water to milk of course lessens its specific gravity, and so facilitates the ascension of the cream."

Now, it would appear from this experiment that we are warranted in deriving a conclusion quite opposed to that just quoted. Here we have 100 parts of pure milk exhibiting 9° of cream; while 50 parts of the same milk mixed with 50 of water, are found to yield 6½° of cream. But the relative proportion of cream existing in the pure and diluted milk is as 2 to 1; while the proportion separable from the two fluids respectively is shown by the lactometer to be as 1·385 to 1 (9 to 6½). It is plain, therefore, that the percentage announced by this instrument is not a true index of the richness of the fluid examined. With regard to the hydrometer, or specific gravity instrument, it is almost unnecessary to say that experience has long since shown it to be quite inapplicable as a means of ascertaining the purity of milk. The normal density of milk has been variously stated by writers, some placing the average density at about 1029, others at 1038, others, again, at some intermediate number. But, whatever may have been the original density of a given sample of the fluid, it is capable of being lowered by the fraudulent admixture of warm water, and raised again to the former figure by the abstraction of a portion of the cream; for the latter will separate rapidly, owing to the previous addition of warm water, and thus the double deception is capable of being carried into effect within a very short period after the milk has been first drawn, and will of course fail to be detected by the hydrometer. It has, therefore, been suggested that the lactometer should always be used in combination with the hydrometer, one being supposed to serve as a check upon the indications of the other.

A very ingenious mode of determining the richness of milk was devised some years since by M. Donné. The instrument which he employed, called a lactoscope, is constructed on a different principle altogether from either of the foregoing, and professes to enable one to judge of the richness of a sample of milk, by measuring the thickness of a film of this fluid through which a luminous body, placed at a certain distance, can be discovered; the more dilute the milk, the thicker will be the film through which the light will be transmitted, and the measure of the thickness is provided for by a scale attached to the instrument. The chief objections to the employment of the lactoscope, at least for ordinary every day use, would appear to be not only its high price, but the difficulty of keeping it in good working order, owing to the delicacy of its construction. It requires to be taken asunder every time it is used, and if not thoroughly cleansed and dried in every part, the screw becomes clogged and its action embarrassed; in fact, if it gets into careless or unskilful hands, it will not fail to become, in a short time, unserviceable. Lastly, of the microscope. With the aid of this valuable instrument the number, size, and shape of the oil, or cream-particles, can be easily recognised by any one who has become expert in its manipulation, and in this way may be formed a tolerably fair estimate of the quality of any given sample of milk; it must be admitted, however, that few, comparatively speaking, have attained to the requisite degree of skill and experience to enable them to pronounce at once a decisive opinion from the use of this instrument without some collateral aid. The expense of a good microscope is also a serious impediment to its general adoption as a lactoscopic instrument. It will appear, therefore, from what has been stated in the foregoing remarks, that an instrument which, in the hands of ordinary observers, will supply the means of determining approximately, or in a rough way, without much trouble, and in a short time, the comparative richness of milk, is still a desideratum. The practical difficulty which has attended the employment of the several methods of milk-testing hitherto in use, is to be attributed in some measure to the fact that upon any scale that can be devised, upon any principle whatever, there is not one point to which we can refer as a standard of purity. The nearest approach we can make to the establishment of such a standard is to ascertain, by experimenting on several specimens of average quality and known purity, whether we can seize upon some physical property which admits of sufficiently accurate measurement for the purpose; then, it has been ascertained that an inferior quality is indicated when the specific gravity is below a certain range—but this can be raised artificially by the abstraction of some of the cream; an inferior quality is also indicated when the percentage of cream is less than a certain number; but the instrument employed for exhibiting this percentage is found to be fallacious, inasmuch as it only shows how much cream has floated to the surface in a given time, and experiment has proved that the richer the milk the less is the cream disposed to float. Many persons are able to judge pretty accurately as to the quality of milk, by carefully observing the transparency which the fluid exhibited when poured in a thin film from one vessel to another; and it would appear that this property, which has already suggested the instrument of M. Donné, might be again turned to account in the construction of a more simple instrument, which would indicate definitely, and enable us to register numerically, the degree of transparency possessed by a given sample; and we should be thus in possession of a very efficient means of estimating the degree to which the milk had been diluted, or how far it fell short of the average quality.

Such an instrument has lately been invented; the principle of its construction is extremely simple, and the experiments instituted with a view of testing its performance, several series of which have been repeated, appear to have been attended with the most satisfactory and encouraging results. The instrument is made of

brass, in the form of a shallow, oblong vessel, capable of containing about an ounce of fluid; the depth of the vessel is made to increase gradually, by means of a slab of white enamel fixed in a gentle slope from one end to the other; this slab is graduated throughout its entire length. Upon this the milk is poured till the vessel is filled, and a cover of plate glass is then put on—this should be done by giving it a sliding motion to exclude air bubbles. When the vessel full of milk is thus covered, the degree of dilution possessed by the sample under examination is estimated by the number of degrees on the enamel which can be read through the glass cover; for the glass being in contact with the edge of the enamel plate at one end, and separated from it by a gradually increasing interval towards the other, the intervening stratum of milk is made to assume the form of a thin wedge. If the fluid under examination be of a rich quality, abounding in oily and caseous particles, it will possess such an amount of opacity that only a few degrees can be discovered on the subjacent enamel when the instrument is held opposite to the light; if, on the contrary, the specimen be of inferior quality, whether from innate poverty, or the admixture of water, the diminution of opacity thence resulting will be evinced by the enamel scale becoming visible through a deeper part of the fluid, or at a greater distance from the commencement of the scale; the degree of translucency, therefore, can be measured by the number of lines visible through the fluid.—*Dublin Medical Press.*

PHARMACY, TOXICOLOGY, &c.

Notes on some of the Chemical Reactions of Morphia, by T. G. Wormley, *M.D.*

Pure morphia was dissolved in water by the aid of just sufficient sulphuric acid, and a small drop of a saturated solution of the reagent was applied to a grain of the morphia solution, placed on a glass slide. The amount of morphia operated upon will frequently be stated in the form of a fraction, it being understood to imply the fractional part of a grain of morphia, in one grain of water.

I. **Nitric acid.**—1. $\frac{1}{100}$th, grain of morphia in one grain of water, when acted upon by *one drop* of concentrated nitric acid, almost immediately assumes a lemon colour, which in a few seconds changes to orange, and finally into a fine red orange, which very slowly becomes yellow.

2. $\frac{1}{250}$th, the mixture is very soon of a lemon colour, changes to a good red orange.

3. $\frac{1}{500}$th, soon lemon colour, which in a few minutes changes to light and then to deep orange.

4. $\frac{1}{1000}$th, very slowly assumes a lemon colour, after some minutes a very light orange.

5. $\frac{1}{2500}$th, only a perceptible lemon colour after some minutes, very faint and only to be seen upon a white ground.

The test is much more delicate and satisfactory when the morphia solution is evaporated to dryness and then a very small quantity of nitric acid applied to the residue.

1. $\frac{1}{100}$th, when touched by a small drop of nitric acid, the deposit immediately becomes fine red orange, which slowly dissolves, giving a solution of the same colour.

2. $\frac{1}{1000}$th, the deposit is at first yellow, soon changing to a bright brown orange, giving a solution of fine orange.

3. $\frac{1}{5000}$th, the acid gives a very evident brown colour to the residue, which when dissolved gives a solution of a very faint colour.

4. $\frac{1}{10000}$th, by using the smallest possible quantity of acid, after a little time the deposit becomes a very distinct faint brown colour.

4. $\frac{1}{15000}$th, the action of the acid is perceptible, but not satisfactory.

II. **Sesquichloride of Iron.**—1. $\frac{1}{100}$th, grain of morphia, with a neutral solution of the sesquichloride of iron gives an immediate faint ink blue cloudiness, which soon forms a good flocculent precipitate.

2. $\frac{1}{250}$th, after a little time the reaction is perceptible, and in a few minutes quite obvious.

3. $\frac{1}{500}$th, after a few minutes the reaction is faint but evident.

4. $\frac{1}{1000}$th, no indication after several minutes.

III. **Iodic Acid.**—1. $\frac{1}{100}$th, if a drop of the morphia solution be added to a drop of a solution of iodic acid to which there has been added a small drop of starch solution, there will be immediately produced a blue precipitate, with a brown solution.

2. $\frac{1}{500}$th, a quite perceptible blue precipitate, with brown solution.

3. $\frac{1}{1000}$th, there is no precipitate, but the mixture assumes a slight brown tint.

IV. **Potash.**—1. $\frac{1}{100}$th, if touched by a small drop of potash solution, it will give an almost immediate white crystalline precipitate, which is much increased by rubbing the mixture with a glass rod. The precipitate is very soluble in excess of potash.

2. $\frac{1}{500}$th, by rubbing, in very little time there is produced a very good precipitate.

3. $\frac{1}{1000}$th, in a few minutes the results are satisfactory, especially with the microscope; the precipitate is in the form of granules.

In applying this test it is important that too much of the reagent should not be used, otherwise no precipitate will be produced.

The carbonate of potash gives the same indications as those above.

V. **Ammonia.**—1. $\frac{1}{100}$th, if the morphia solution be touched by a very small drop of aqua ammonia, or still better by suspending a drop of the ammonia over the morphia solution for a few moments, the latter solution does not become cloudy, but in a few seconds small crystals are produced which soon become large and abundant. If, after the application of the reagent, the mixture be rubbed, it will give almost immediately a fine crystalline deposit.

2. $\frac{1}{500}$th, in a few seconds crystals appear, and soon are rather abundant. By rubbing they are much increased.

3. $\frac{1}{1000}$th, by rubbing one or two minutes, there is a very good precipitate, consisting of small prisms and granules.

Carbonate of ammonia behaves the same as ammonia.

The above reactions of potash and ammonia would seem to indicate that morphia was not entirely soluble in 1000 parts of water.

VI. **Iodide of Potassium.**—1. $\frac{1}{100}$th, by rubbing, immediately rings of granules and prismatic crystals, which in a little time become almost a mass.

2. $\frac{1}{500}$th, very soon granules and crystals.

3. $\frac{1}{1000}$th, after a little time quite satisfactory.

With the acetate of morphia the reagent acts more slowly, and the results are not as satisfactory.

VII. **Chromate of Potash.**—1. $\frac{1}{100}$th, without rubbing, the reagent gives no precipitate in several minutes, but if stirred, immediately rings and fine crys-

talline prisms, which soon become abundant. The acetate of morphia, when treated as above, gives no indication for some minutes, then crystals begin to form along the edge of the drops, and after a little time the results are satisfactory, but not nearly so good as in the sulphate.

2. $\frac{1}{500}$th, after rubbing about one minute, small granules appear; after several minutes no distinct crystals.

3. $\frac{1}{1000}$th, by rubbing several minutes, granules, not abundant.

VIII. Bichromate of Potash.—1. $\frac{1}{100}$th, very soon a yellow amorphous precipitate begins to form, which in a few minutes is quite good, but remains amorphous. The precipitate slowly dissolves in several drops of acetic acid.

2. $\frac{1}{150}$th, the precipitate appears after several minutes.

IX. Tannic Acid.—1. $\frac{1}{100}$th, immediately a bluish white cloudiness, which soon forms good dirty white flakes. The precipitate readily dissolves in a few drops of acetic acid and in solution of potash.

2. $\frac{1}{500}$th, soon quite a good bluish white precipitate.

3. $\frac{1}{1000}$th, after a little time the precipitate is quite perceptible.

X. Carbazotic Acid.—1. $\frac{1}{100}$th, an immediate copious bright yellow amorphous precipitate, slowly soluble in a few drops of acetic acid.

2. $\frac{1}{500}$th, very soon quite obvious.

3. $\frac{1}{1000}$th, no indication.

XI. Chlorine.—1. $\frac{1}{100}$th, if 10 grains of the morphia solution be taken and a stream of chlorine be passed into it, the mixture becomes a deep yellow, which upon the addition of ammonia is changed to deep brown, not affected by excess of ammonia or acetic acid.

2. $\frac{1}{1000}$th, 10 grains of, with chlorine gives a yellow tinge, with ammonia, brown.

3. $\frac{1}{5000}$th, 10 grains of, no indication with either the chlorine or ammonia.

XII. Bichloride of Platinum.—1. $\frac{1}{100}$th, an immediate rather copious yellow amorphous precipitate.

2. $\frac{1}{150}$th, no indication.

XIII. Bromine in Bromohydric Acid.—1. $\frac{1}{100}$th, an immediate copious yellow amorphous precipitate, which soon dissolves if there is not excess of reagent.

2. $\frac{1}{1000}$th, an immediate green yellow precipitate.

3. $\frac{1}{2500}$th, a quite distinct but not copious precipitate.

4. $\frac{1}{5000}$th, no indication.

XIV. Iodine in Iodide of Potassium.—1. $\frac{1}{100}$th, a copious red brown amorphous precipitate, which slowly dissolves in a few drops of acetic acid, but readily without the production of a white precipitate, in a solution of potash, this reaction distinguishes morphia from strychnia. If a very small quantity of reagent be applied there will be no precipitate, or it will soon dissolve.

2. $\frac{1}{1000}$th, a very fine red brown precipitate.

3. $\frac{1}{10000}$th, an immediate cloudiness, which soon becomes a fine brown yellow precipitate.

4. $\frac{1}{20000}$th, a green yellow precipitate.

5. $\frac{1}{50000}$th, after a little time the precipitate is very perceptible.

6. $\frac{1}{100000}$th, after time the precipitate is perceptible. The best indications are obtained from dilute solutions, by placing a drop of the reagent by the side of the morphia solution, and allowing them to flow together.

XV. Terchloride of Gold.—1. $\frac{1}{100}$th, immediate copious yellow amorphous precipitate, which immediately begins to darken; the addition of a drop of potash gives a dark purple precipitate with a deep purple solution. A full drop of reagent should be used, otherwise the precipitate will dissolve.

2. $\frac{1}{1000}$th, in a few seconds, a copious greenish yellow precipitate, which soon begins to darken; upon adding a drop of potash the precipitate nearly all dissolves, and the solution slowly darkens, as does also the precipitate.

3. $\frac{1}{2500}$th, very soon a fine yellowish precipitate, which with a drop of potash entirely dissolves, giving a slight yellow solution.

4. $\frac{1}{5000}$th, much the same as 3.

5. $\frac{1}{10000}$th, in a few seconds the precipitate is very good.

6. $\frac{1}{20000}$th, in a very little time quite good.

7. $\frac{1}{40000}$th, in a few minutes quite satisfactory.

If a very small quantity of the reagent be applied to a strong solution of morphia, there will be no precipitate, or, if produced, it will dissolve upon agitation. This, I presume, explains the statement of Taylor[1], that morphia gives no precipitate with chloride of gold; and, also, that of Pereira[2], who states that the precipitate produced, "on shaking is taken up."

If the precipitate produced from about 20 drops of a $\frac{1}{1000}$th, or stronger solution, be heated, the precipitate does not dissolve, but becomes brown or dark from a reduction of the gold salt; if a $\frac{1}{2500}$th solution be used, the precipitate dissolves upon heating, but immediately upon cooling, the mixture darkens from the presence of small flakes, which after a little time adhere to the sides of the tube; in a $\frac{1}{5000}$th solution, the precipitate readily dissolves upon the application of heat, giving a yellow solution, which undergoes but little change after standing several hours.

With all the above reagents the acetate of morphia gives the same results, except when otherwise stated.

Pharmaceutical Notes.

Detection of Alcohol in Chloroform.—M. Lepage, a pharmacien at Gisors, has published[3] some "Remarks on the Methods proposed for proving the Presence of Alcohol in Chloroform." The chromic acid test after a great number of experiments he is disposed to reject as inconclusive. After repeated washings and rectifications he found that chloroform of his own manufacture still reduced the chromic acid. Soubeiran's test the author finds will not detect the presence of less than five or six per cent. of alcohol, but the test is very simple. Shake the chloroform in a test tube with sweet oil of almonds: the mixture remains clear if no alcohol be present, but in the contrary case it becomes more or less milky. The most delicate process is that proposed by M. Roussin, which, according to the author, will detect one-thousandth part of alcohol. M. Roussin shakes together in a stoppered bottle a few grammes of chloroform and a very small quantity of binitrosulphide of iron. If after allowing the bottle to rest for a minute or two the chloroform remains colourless it may be considered pure, but if alcohol be present a brown tint will be produced more or less deep according to the amount of the alcohol.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture IV. *On Earthquakes.*

Of all the events that take place in nature, earthquakes are the most terrible; they come without warning—their operation is so rapid as to defy observation—they are not confined to time or space; they are connected with, if they do not

[1] *On Poisons*, Amer. Edit. p. 624, 1848.
[2] *Mat. Med.* Amer. Edit. vol. ii. p. 2061, 1854.
[3] *Journal de Pharm. et de Chim.* August 1860, p. 93.

cause, enormous destruction to human life and property, and they have the peculiarity of alarming most those most accustomed to their operations. The subject of my lecture to day, therefore, though it may seem unattractive, as involving statistical matters, is not without special points of interest.

I propose to explain to you, first, the nature and extent of those singular convulsive throes of the earth to which the word *earthquake* has been applied, and then show you how, by a large series of calculations, generalising from numerous observations spread over all historic time in all civilised countries, it has been ascertained that a certain amount of order and system are traceable in these events, especially in reference to those months and seasons of the year at which they are most common in different parts of the world, the frequency of their recurrence, and the position of the countries that are chiefly exposed to their disturbing action. I hope thus to attract your attention to one of those mutual relations between very dissimilar phenomena, of which several have been determined of late years in many departments of science.

The stability of the earth is a relative not a positive fact. In a certain sense the expression may be used correctly, for the relative position of various objects, natural and artificial, is as little affected by earthquakes as by the revolution of the earth on its axis, but it needs only a short consideration to discover that the surface of the earth is never long in exactly the same condition, Disturbing causes are incessantly at work, and even without earthquakes, or abrupt convulsive upheavals of isolated tracts, there are everywhere indications of restlessness, not unlike the occasional movements of a living framework in a state of repose, but not of death.

This tendency to constant change in its material structure must be regarded as one of the symptoms of the earth's vitality, and it seems not improbable that this vitality is essential for the well being of its inhabitants. The life of man exhibits a longer and more active vital principle than that of the reptile; the reptile has more vitality, even in his long periods of repose, than the insect has while in its intermediate state of chrysalis, and the insect in the chrysalis seems to be more possessed of vitality than the animalcule hovering between life and death for an indefinite time in dry air, and continuing its interrupted existence whenever moisture is applied. Without asserting that the earth itself is only a step further removed from life, we still see that it also has its own proper stimuli of electricity, heat, and moisture, and we shall find not a little evidence tending to show that in undergoing the action of these stimuli it is subject to a certain degree of periodicity, so that the slow upheavals and sharp sudden rents affecting its outer film come under the influence of laws wonderfully allied to those that affect ourselves and all organic nature.

Of the various theories of earthquake action I shall say little, but I will just put before you the facts and the laws that stand in immediate relation with them.

In the first place, the temperature of the interior is not the same as the temperature of the surface of the earth. We all know that the temperature of the surface varies exceedingly at different times of the day in different seasons of the year, and at different parts of the world, but when we dig down a certain depth below the surface we get less and less variation, until at last we come to a depth at which the temperature remains constant all the year round, and then, if we go lower, the temperature is also constant, but begins to increase with the increasing depth, and goes on to the greatest depth at which it has been found possible to penetrate the earth by mining operations or well boring. We can, however, reach below those depths, by watching the operations of nature, and we then find in various places jets of water thrown up varying in temperature, and hotter in proportion to the depth from which they rise. There are other evidences, rendering it probable that the temperature in the interior of the earth increases as we descend, within certain limits. I do not wish to open the question as to whether it goes on increasing to indefinite depths, but it is quite certain that it increases, as far as we know. It is clear that the temperature may still continue to increase, and, indeed, whenever communication is open in the neighbourhood of volcanoes, the result shows that the temperature is very high. Such observations however do not prove that the same law continues to act, because the very fact of volcanic agency may be exceptional.

Increase of temperature as the result of increased depth, would be affected by the constant wearing away of the surface at one place, and its deposit in another, and would tend to induce further changes. There is another possibility, and the evidence we have makes it almost a probability, namely, that there are hollow spaces in the earth, and if so, those hollow spaces may exist at considerable depths, and be occupied partly by air, or other gases, and be in a condition to admit of explosive disturbance by some causes of change.

Thus if in these hollow spaces certain minerals are exposed to the action of certain other known substances, there would be explosions produced something of the nature of those which take place when we bring fire in contact with gunpowder, and in this way a sudden and convulsive force may act on a portion of the earth's surface, tending to produce a change in position. There must, however, be some space for movement, as well as some change going on below, to account for the movements that take place above.

If this force were sufficient to lift up the whole superincumbent mass, but not to break it, then there would be a slow movement of elevation going on for a long period without producing any actual disruption or earthquake. This slow movement of elevation may take place with regard to a large or small extent of surface. There is a very remarkable instance, on a small scale, of this upheaval, to which I may refer you. It is the history frequently given of the celebrated temple of Jupiter Serapis, near Naples, built in the early part of the Christian era, if not before. It appears to have been constructed near the sea beach, but within a few centuries that portion of the earth sunk down without disturbing the proportions of the temple (the pillars being vertical to this day). After that it was lifted up partially, and another floor was made; then again it went down, and once more came up. These changes having been produced in an apparently small space of ground proves that alterations of level may go on for centuries without producing any of the ordinary results of earthquake.

I may mention also the condition of Scandinavia, which is known to be undergoing an alteration of this kind, but much slower, and on a larger scale. In that country the rise is only a few inches, and perhaps less than that in each century, but still it is a rise, and there is no doubt whatever of the fact. It is clear, therefore, that slow elevatory movements may take place, and that they may have nothing whatever to do with convulsive movements, although in the same country there sometimes occur earthquakes properly so called. The two phenomena may therefore be produced under somewhat different conditions. In the one case there is not sufficient force to burst through, owing perhaps to the great depth of the disturbing cause, while the shallower disturbance results in an earthquake.

There are numerous movements of the latter kind, and earthquakes generally have a relation to volcanoes, phenomena which involve the relief of the force which is tending to lift up slowly, or to burst suddenly, the earth's crust. Whenever the bursting is produced the earth is generally relieved. Of course it is quite possible that even when a vent is opened, and continues for a certain time, it may then cease, and the superincumbent mass may sink again and close the vent. In this way the operation may go on from time to time, sometimes on a very large scale. Such is in a few words a description of the paroxysmal event which is called an earthquake. Each one includes a succession of shocks, accompanied by concussion. Loud rolling rumbling sounds are also heard to a great distance, and a very peculiar vibration of the earth's crust is felt, including an actual

cracking of the surface, to the extent of a few feet or yards, or even hundreds of feet, although there is very rarely any open communication made with the depths below. The fracture merely consists of the fracture of matter which does not easily give way, or which, when it does give way, is severed. Thus if you take a piece of india-rubber or gutta-percha and elevate it from below, it does not tear or break, although if you take a piece of glass the same force would crack it easily. Now some portions of the earth are tough, and may be elevated, other parts are not tough, and must be broken.

The time occupied by an earthquake varies a good deal, but each shock is generally very short, being measured by seconds, or parts of a second. The actual movement is thus very quickly over, and it is very difficult indeed to get an observation in which there are means of determining the time, even if the presence of mind of the observer enables him to notice the events. Take the accounts of two, or three, or half a dozen persons, and you will find that each is affected in so different a way, mentally, that it is almost impossible their accounts can agree.

An earthquake generally moves in some one direction rather than in another, that is, it is observed in successive places at different times, and those places when marked on a map appear to be in a zone or band on the earth, not much curved. An earthquake may be felt at one place first, and then in a succession of others having a certain compass bearing, but not much, at right angles to this direction.

Thus earthquakes have a direction, and they have also limited areas, small or great. These vary from a few square miles to many millions of square miles, but each one has its own.

I have not described yet what the earthquake really is. If you take a trough of water, and put a stone with a string tied to it to the bottom, and then lift the stone by the string, you will produce a wave, and if you float a few corks on the water, you will find that the wave travels along to the edge of the basin and lifts up each cork as it goes on, but does not carry the corks along. The up and down motion has been transferred from one part to another, but the water has not itself been moved along. The particles represented by the corks have been moved up and down, but not to the right or left. This is just the condition of the earth. It is to some extent elastic, and when a wave is produced by lifting a portion of the surface by violence from below, and let down again, the motion is continued in all directions, but the wave only moves—that wave is the earthquake.

Now we must come to the statistics of earthquakes. Earthquakes are distributed in space and distributed in time.

First of all I will endeavour to explain to you the result of observations of earthquakes as to distribution in space.

[The Lecturer here pointed to a map which represented by red spots the different places where volcanoes have happened.]

First of all, let us take the case of the countries in which we are most interested. In the British Isles there are many. Within the present century there have been no less than 110 different shocks recorded, none of them, it is true, of great magnitude, but all sufficient to produce a certain effect. The whole number of earthquakes recorded in the British Islands is about 234. I must remind you that there is no reason to suppose that the number of earthquakes has increased, because so many more are recorded now than formerly. It is only lately that people have observed these things and taken an interest in them, so as to record those of smaller importance. Formerly there was no record of passing events. Now all are mentioned in newspapers, and no important event takes place without being talked about. Then of the earthquakes, even of the last century, we have few statistics, and the numbers recorded can hardly be considered as bearing any definite proportion to the events, until we come to the figures of the present century. Had I merely said that some three or four hundred earthquakes had been felt in England since the beginning of history, it would not have given the right impression, or produced the same effect on your minds, as when I mention that 110 of them took place during the first half of the present century.

In Scandinavia, including the whole of the north-western extremity of Europe and Iceland, there have been recorded about as many earthquakes as in the British Islands. Earthquakes then continue northwards of the British Island region. East and south of the British Islands we have France, Belgium, and Holland, and in these countries together there have been a very large number of earthquakes, both in former times and lately. Whether it arises from the fact that within the last two centuries these countries have really been proportionably more subject to earthquakes than they are now, or whether they have been better recorded there than elsewhere, it is impossible to say. There have been no less than 702 earthquakes recorded in those countries altogether, of which 292 were recorded in this century.

A little further to the east we come to the Rhine basin and Switzerland, where there have been altogether 557, of which 170 have occurred in this century. In the basin of the Danube there have been 318, of which 145 have been in the present century. In the Italian peninsula, which is the great region of earthquakes, there have been as many as 1362 recorded, of which 478 have been within the last century; and in the eastern parts of the Mediterranean there have been 200 within the last century. It is quite clear that over the whole of western Europe, through Scandinavia and the British Islands including also the north of Africa, which is part of the district, there is a very great amount of earthquake action which has been going on incessantly. In eastern Europe the force seems to die away towards the north. Towards the east, following the line of the great mountain chain and valleys, earthquake action continues through Asia and there seems to follow the river valleys. Thus almost the whole of Europe and part of Asia are subject to these movements. With regard to Asiatic earthquakes the number recently recorded is not so large as in Europe. In this case, as in others, the reason probably is that we have only the more marked and larger instances recorded. The small ones, sometimes quite as important, have not been mentioned. Then there is another thing to be observed. There are large tracts of earth in the interior of Africa, of which we have no records whatever. The facts recorded have reference to those portions of the earth of which we know most, and here we find the distribution follows the law I have mentioned. For the most part earthquake action extends along river valleys.

There is another remarkable fact, namely, the distribution of earthquakes across the Atlantic. It is not very easy to prove this, but it has been found that there are two or three districts in which earthquakes have been frequently recognised by persons sailing over the ocean. There is one particular zone near the equator which is exceedingly singular in this respect. A sort of zone seems to connect the lands of Europe and America, and here earthquake action is common, and possibly there are here volcanoes.

With regard to the northern part of the Atlantic we know that the great earthquakes of Europe have more than once disturbed the whole of the ocean bottom and the land on the other side. Earthquakes have been felt within close limits of time on the shores of the West Indies and several parts of Africa, so that in this way the extent of earthquake area is proved by positive observations.

I now wish to point out the enormous range of volcanic action accompanied with earthquake action in most parts of America. The American volcanic district ranging all along the west coast is remarkable and has always been known since the discovery of the continent as a zone of earthquake as well as volcanic action. The north eastern district is also subject to earthquakes, and one may say that throughout the whole land there is a considerable amount of earthquake action.

(To be continued.)

NOTICES OF BOOKS, PATENTS, &c.

Lehrbuch der Organischen Chemie oder der Chemie der Kohlenstoffverbindungen. Von Dr. Aug. Kekulé. Erste Lieferung. Erlangen: F. Enke, 1859.

This treatise, the first part of which now lies before us, promises to supply very efficiently an important desideratum, and to present us with a work which has at present no representative in English chemical literature. We do not refer to the adoption of the unitary notation of Gerhardt, but to the really philosophical spirit in which the relations and principles of construction of organic bodies is discussed. Chemists of course cannot but be grateful for the lengthy catalogues and minute details of such a complete work as that of Gmelin, but it is time that tedious accounts of methods of preparation and long accounts of insignificant salts were banished from the smaller handbooks, which profess to give the truths of a science not the processes of an art.

The brief historical account of organic chemistry with which the work opens is well written. We cannot say as much for the pages devoted to a description of the methods employed in organic analysis; it would have been better had the reader been referred to a separate treatise on manipulation for information on all such points. Several of the processes are but inadequately described, some of those noticed are obsolete, or nearly so, and into the accounts of others strange errors have crept. In a combustion performed in a current of air, who would think of using, for the estimation of water, chloride of calcium, when it has been repeatedly shown that this substance is incapable of completely retaining water under such circumstances? The way to calculate percentages, formulæ and equivalent weights, and also the mode of taking the vapour densities and boiling points of organic compounds, is clearly and concisely given.

In the chapter noting the various views which have been taken of organic compounds, we have (p. 58) an amusing list of the numerous ways, nineteen in all, in which acetic acid has been regarded. The reckless and playful use which many of the authors of these views have made of signs, lines and brackets, demands more space than we can afford, otherwise we should have liked to reproduce these formulæ here; we cannot, however, refrain from writing acetic acid after Rochleder and after Buff respectively,—

$$C_2\left\{\begin{matrix}C_2H_3\\O\\O\end{matrix}\right\}O+HO; \qquad C_2\left\{\begin{matrix}C_2\left\{\begin{matrix}O_2\\H\end{matrix}\right.\\H\\\hline H\end{matrix}\right\}O_2.$$

Prof. Kekulé's historical accounts of the atomic, electrochemical, radical, dualistic, substitution, type and nucleus theories, are short yet full of interest. But it is the hearty appreciation with which the development of Gerhardt's views is traced that specially engages the reader's attention. The examples of formulæ and reactions cited as illustrations are invariably characteristic and to the point.

In the theoretical part of the work the description of the character and function of atoms, molecules and equivalents, is accomplished without the least confusion, and in some respects very ingeniously. The essential duality of the free elementary molecule is beautifully shown by a series of 13 varied reactions selected with great judgment (p. 101), in which double molecules of hydrogen are invariably eliminated. Equally appropriate examples, both of analysis and synthesis, have been chosen to show that one *molecule* of Cl, of O, of N, of Cy, of K, contains two *atoms* of the element. The equivalent relations, as accepted by Kekulé, of the three great types — HCl, HHO, and HHHN, is clearly pointed out by the following statements:—

1 atom H is equivalent to 1 atom Cl
1 „ O „ „ 2 atoms Cl
1 molecule H_2O „ 2 molecules HCl
1 „ HCl „ 1 mol. NO_3H, or 1 mol. $C_2H_4O_2$.

Now 1 molecule of a dibasic acid is equivalent to 2 molecules of a monobasic acid —

1 mol. SO_4H_2 is equiv. to 2 mol. HCl or 2 mol. $C_2H_4O_2$.

Again, when a dibasic is compared with a tribasic acid the following relation is observed:—

1 mol. PO_4H_3 equiv. to 3 mol. HCl or 1·5 mol. SO_4H_2.

Such equivalent relation of many salts containing polyatomic constituents is often, however, overlooked. Thus the phosphate of bismuth, $BiPO_4$, containing, as may be granted, a triatomic basic combined with a tribasic acid constituent, seems at first sight to be equivalent to 1 molecule only of HCl, while in reality it is equivalent to 3. An enlargement of the method now so extensively employed to indicate the polyatomic character may be here occasionally employed with advantage. The following table will serve to exhibit our meaning:—

	Cl′ (monobasic),	S″ (dibasic),	P‴ (tribasic).
Hydrochloric acid	HCl′	H (ClO$_4$)′	Perchloric acid.
Hydrosulphuric acid	H_2S″	$H_2(SO_4)$ ″	Sulphuric acid.
Phosphor. hydrogen	H_3P‴	$H_3(PO_4)$ ‴	Phosphoric acid.

If this manner of elucidating the characteristic value of one molecule of the tribasic phosphate of bismuth, above mentioned, be adopted, it will then become Bi‴ (PO_4)‴, and is thus seen to be equivalent to 3 molecules of HCl. The constitution of the tribasic phosphate of ethylene will in like manner be apparent when its formula is thus written $(C_2H_4)^{iv}_3(PO_4)^{vi}_2$: its molecule therefore is equivalent to 3 of H_2O, or 6 of HCl.

The sections on the functions of elements and the theory of types are admirably planned and executed. Regarding the hydrogen (HH) and hydrochloric acid (HCl) types as really one and the same, the author arranges the compounds of the various elementary acid radicals under the three usually received primary types; but, while he allows the great advantage of recognising as a fourth type a group containing tetratomic acid constituents, yet he here seems to hesitate in admitting such a type to an equal rank with the other three.

One or two examples will serve to give some idea of the way in which our author illustrates the application of the theory of types to the more complicated organic bodies. By doubling, tripling, quadrupling the three types, and by uniting two or three types together, a great variety of complex types are obtained, and under these various organic substances may be significantly expressed.

Type. *Epichlorhydrin.*

$$\left\{\begin{matrix}HCl\\\left.\begin{matrix}H\\H\end{matrix}\right\}O\end{matrix}\right. \qquad (C_3H_5)''\left\{\begin{matrix}Cl\\O\end{matrix}\right.$$

Type. *Oxamic acid.*

$$\left\{\begin{matrix}\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N\\\left.\begin{matrix}H\\H\end{matrix}\right\}O\end{matrix}\right. \qquad \left.\begin{matrix}H\\H\\(C_2O_2)''\\H\end{matrix}\right\}\begin{matrix}N\\O.\end{matrix}$$

Type. *Monochlorhydrin.*

$$\left\{\begin{matrix}\left.\begin{matrix}H\\H\end{matrix}\right\}O\\H\ Cl\\\left.\begin{matrix}H\\H\end{matrix}\right\}O\end{matrix}\right. \qquad \left.\begin{matrix}H\\(C_3H_5)''\\H\end{matrix}\right\}\begin{matrix}O\\Cl\\O\end{matrix}$$

Type. *Trichlorhydrin.*

$$\left\{\begin{matrix}HCl\\HCl\\HCl\end{matrix}\right. \qquad (C_3H_5)'''\left\{\begin{matrix}Cl\\Cl\\Cl.\end{matrix}\right.$$

We have not space to quote from the sections on chemical metamorphoses, but can affirm that an attentive study of them in the original work will be well repaid. Valuable novelties in the manner of formulation everywhere attract us.

Passing over the accounts of radicals and rational formulæ, we come to an important chapter on the chemical nature of carbon, and on the constitution of compounds containing carbon. Here the tetratomic value of this element, partially accepted in an earlier section of the book, constitutes an important feature. The following compounds cited by the author may be regarded as illustrating the atomic function of carbon. The dashes are our own:—

Marsh gas	CH_4	Carbonic acid gas	CO_2''
Chloride methyle	CH_3Cl	Phosgene gas	$CO''Cl_2$
Bichloride methylene	CH_2Cl_2	Bisulphide carbon	CS''_2
Chloroform	$CHCl_3$	Prussic acid	$CN'''H$
Chloride of carbon	CCl_4	Chloride cyanogen	$CN'''Cl$

The definitions given of isomerism, polymerism, metamerism, and of basicity and its laws are clear and illustrated by appropriate examples. A chapter on the physics of organic chemistry concludes the first part of the work. We shall be able to speak in detail of the method of classification adopted by Kekulé when we possess the second instalment of his text book. His system is founded upon the ideas of type, homology, and atomic equivalency. Prof. Kekulé, in regarding organic chemistry as "The chemistry of carbon compounds," treats it as a separate department of the science partly for convenience sake, but chiefly in virtue of its development from the study and investigation of animal and vegetable products. His remarks recall Dr. Hofmann's definition of organic chemistry, "The wanderings of carbon."

CORRESPONDENCE.

The Sale of Poisons.

To the Editor of the Chemical News.

Sir,—Your remarks upon the sale of poisons question, and the letters which you publish upon the same subject, might lead to the supposition that a remedy was at hand capable of affording a solution to this almost insoluble matter. But the strong hopes which are built upon a weak foundation are eventually the greatest obstacles to success. Whether or not any measures are ever found practically successful, I have no hesitation in saying that all those which have lately been promulgated will be found upon trial to be very far from sufficient for their purpose.

Those who can observe what takes place in the obscure corners where we have linked together the sale of bacon, black draughts, and butter, candles, calico, and cod liver oil, will have a good idea of the real difficulties of the case as regards the sale of poisonous medicines. And the difficulties which beset any rules for preventing mistakes in administering the same, will not be estimated lightly by any who have their share of pauper customers. With the poor the vinegar cruet does duty in turn for laudanum or tincture of rhubarb, the porter bottle of to-day becomes the medicine bottle to-morrow, containing a cooling aperient or a cooling lotion, and has no label to indicate its contents; nor is the remedy in the hands of the chemist. If the poor man wants the former, he buys two ounces of Epsom salts, one ounce of cream of tartar, and half an ounce of magnesia, puts them into a bottle and fills it up with water; if the latter is required, he buys a pennyworth of sugar of lead, and in like manner dissolves it in a bottle of water. How is the law to affect such cases? And such are the cases which stand most in need of reformation. Accidents are comparatively few among those who can afford to have their dispensing done by Messrs. Savory and Moore. But there are many shops between New Bond Street and Whitechapel, many grades of trade between the metropolitan and the village. If a catholicon is to be found, it is more likely to be discovered by those whose acquaintance is not limited to either extremity of the long chain which links the apothecary with the huxter.

There can be little doubt that the suggestions of Messrs. Savory and Moore might be useful if universally acted upon, but it is *equally certain* that they never can be universally carried out, and *almost equally certain* that the provisions for preventing accidents in the administration of poisonous medicines would be useless or perhaps worse than useless if acted upon in some cases and not in all. With regard to the prevention of mistakes behind the counter, there is less danger to be apprehended from a partial adoption of the proposed precautions, but there is about equal certainty of their never being universal. In poor establishments many articles are habitually kept in the bottles in which they are supplied by the wholesale dealers, and even in good businesses this is done frequently with such articles as Battley's Liq. Belladonnæ, or Browne's Chlorodyne.

Confining our attention to shop regulations, being the more practicable part of the subject, even it appears to be beyond the reach of direct law. Any *external* force compelling the storing of poisons in peculiar bottles, or in locked closets, will ever be futile as protections against accidents in dispensing. Any really useful precaution must come from *within*, as the result of a conscious responsibility. If Savory's bottles were adopted in one half the shops in the kingdom (it is not likely that any mere recommendation would secure their use in anything like so large a number), and it was afterwards found that three-fourths of the accidents occurred in the shops where they had not been adopted, could we expect that the compulsory use of them would reduce the accidents to one-third in the remaining half? Certainly not. We might conclude that in the first case they had been adopted by those who seriously felt the responsibility of their position and were anxious to make use of every additional precaution (and when adopted in this spirit they will be useful); but in the other case, those who did not use them from free choice, but only when compelled, will include the careless and indifferent, they will not accept them as an additional help, but submit to the regulation as an unwelcome trouble and expense, or adopt it as a substitute for personal care and responsibility. And the latter state of that class will be worse than the former. Dangerous medicines will be every now and then introduced, and from pure carelessness, or from want of a poison bottle, they will find their place upon the shelf in a common bottle; and because the habit has been formed of trusting to the innocence of the contents of all common bottles, these occasional omissions will become a source of increased risk. So far from the number of accidents being reduced to one-third, they might even become more numerous. This is a difficulty which is inherent to all projects for *forcing* care, or making any substitutes for it. Success can scarcely attend any regulations, but such as are founded upon the confining of retailing or dispensing poisonous materials to those who have been educated especially for the trade, and who are ready to prove by submitting to examination, that they are acquainted with the doses and properties of the articles they deal in, and are possessed of such knowledge and experience as would give a medical man confidence in trusting them with the dispensing of dangerous remedies. They should know where danger lies, and they should know what to do in case of accident. There are few idiosyncrasies of such a nature as to be habitually negligent of the necessary precautions after such training. I know you advocate free trade in medicine, and free trade in poisons; but I think you must acknowledge that it is only reasonable to purchase that liberty at such a price as will afford the public some security that their safety has not been sacrificed for the sake of theoretical notions about the freedom of trade, or for the sake of indulging the indolence of a class. I have endeavoured to show that the first element of safety is the feeling of responsibility. The next essential is a conscientious attention to the full inspection of the label in every case. Whatever tempts to the neglect of this, or appears to diminish its importance in any way, adds to the chances of accident. The size, form, or colour of the bottle, the colour of its contents, and the place in which it is kept, are already too apt to tempt the neglect of a careful reading of the label. And it must be remembered that mistakes of a serious nature might readily occur among those articles which would not be included in the precautions proposed by Messrs. Savory and Moore, or those proposed by any others who have offered suggestions for legislation upon this subject. For example, if 20 grains of gamboge were given in mistake for the like quan-

tity of rhubarb, or turmeric, or saffron, or if two or three drams of "tinct. canthar." were given for a like quantity of "tinct. camphor. co.," the precautions which I am now advocating alone afford us protection against these less dangerous, as well as the more dangerous class of mistakes; they are already gradually and unostentatiously coming into operation. It is folly to despise or neglect them because they do not promise all at once as much as we would wish. The best measures are generally the least convulsive: let us encourage therefore every reformation which is founded upon right principles, and welcome every step which is taken in the right direction.

In conclusion let me repeat, the poison trade should be confined to the hands of those who are fit to be trusted with the responsibility.

A careful attention should be paid to having everything distinctly labelled, whether it be considered dangerous or not.

And it should be made a matter of conscience to read the whole of the label in every case, trusting to no other mode of distinguishing the article.—I am, &c.

BARNARD S. PROCTOR.

11, Grey Street, Newcastle-on-Tyne, August 28, 1860.

Infinite Divisibility of Matter.

To the Editor of the CHEMICAL NEWS.

SIR,—In No. 35 of the CHEMICAL NEWS, your correspondent, Mr. T. S. Barrett, gives a proof of the "Infinite Divisibility of Matter." When, however, he asserts that "there are two kinds of matter, solid and fluid," he seems to allow the duality of atoms, apparently forgetting that solidity or fluidity is a mere *condition* or difference in power of cohesion. Again, how could it be said (Ax. 7) that no amount of solid molecules could form a fluid, since, as I said before, it is only a matter of intensity of cohesion, *not* of actual constitution. Moreover, if the force of cohesion be disputed, it must rest on an assumption of the "Infinite Divisibility of Matter," which of course, in the case in question, would be a *petitio principii*. While I state the physical objections to this theory, I must acknowledge that the *metaphysical evidence* (and indeed the question is more one of metaphysics) is in favour of the Infinite Theory. Trusting that these remarks, possibly new, may find insertion in your valuable paper, as relating to a most important subject,—I am, &c.

H. H.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Vanadium in Clays.—We announce for the benefit of any of our readers who may be at work on clays, that M. Terreil [1] has confirmed the presence of vanadium in many. He has also found traces of titanium and tantalum in some. The quantity of vanadium found has indeed been very small, but, as M. Terreil gravely remarks, "when we consider the enormous amount of clay on the face of the earth we must see that vanadium is not so scarce a metal as we have been led to believe."

Double Salts of Iodide of Antimony.—The iodide of antimony forms beautiful double salts with the iodides of the alkaline metals, several of which are described by Schaeffer.[2] He obtains them by adding the iodide of antimony in fine powder to hot saturated solutions of the other iodides, and then slowly evaporating the solution at the ordinary temperature. He generally used three equivalents of the alkaline iodide to one equivalent of the iodide of antimony, and in contradiction to Nicklès asserts that the latter is never decomposed.

Iodide of Antimony and Potassium forms quadrangular plates with angles frequently truncated. They appear blackish brown by reflected, and red by transmitted, light. By heating to 100° for some time they lose all their water and are then of a beautiful vermilion colour. The composition of the salt answers to the formula:—

$$3KI.2Sb_3 + 6HO.$$

Iodide of Antimony and Sodium forms rectangular prisms of an orange yellow colour. Anhydrous the salt is orange. Formula: $3NI.2SbI_3 + 24HO$.

Iodide of Antimony and Ammonium. A hot saturated solution of one equivalent of iodide of antimony and three equivalents of hydriodate of ammonia deposits successively three different salts: the first, $3NH_4I.4SbI_3 + 18HO$ forms rectangular prisms of a scarlet red colour. When dried it becomes crimson red. The second, $3NH_4I.2SbI_3 + 6HO$ a good deal resembles the potash salt described above. The third, $4NH_4I.SbI_3 + 6HO$ presents itself in large rectangular prisms with pointed edges, almost black, but ruby red when seen by transmitted light through the thin parts: when dried it becomes of a carmine colour.

Iodide of Antimony and Barium. Translucid rhomboidal prisms of a deep orange colour, and of a glassy lustre. Formula: $2BaI.SbI_3 + 18HO$.

Water decomposes all the above salts with the deposit of the basic iodide of antimony. Hydrochloric, acetic, and tartaric acids dissolve them. Sulphide of carbon removes the iodide of antimony from them. Heat decomposes those with a fixed iodide base, giving a sublimate of iodide of antimony; the ammoniacal salts sublime with partial decomposition.

How Fogs are Produced.—If into a glass globe filled with air, and having the sides moistened with water, says Dr. Millon[3], we simultaneously introduce one or two grammes of liquid ammonia, and fifteen or twenty drops of sulphide of carbon, we see after some time a dense cloud formed, which fills the globe and lasts for several hours. The doctor is unable to explain this apparition by any direct action of the ammonia and sulphide of carbon, either on each other or on the water, and he therefore concludes that the phenomenon known under the name of fog may be manifested in a moist atmosphere whenever substances come together therein indifferent to each other and to water; it is only necessary that they be changed at the expense of the air and water into new substances, each one no doubt endowed with a special optical property. Perhaps, adds the doctor, meteorology may draw from this fact some explanation to perfect the physical theory of certain fogs and clouds.

Volatility of Mercury with the Vapour of Water.—Professor Mallet[4] confirms the observations of Stromeyer on the evaporation of mercury with the vapour of water at comparatively low temperatures. Some mercury got mixed in his laboratory with a porous clay, which was dry to the touch, but which gave off 8 or 10 per cent. of water when heated to 100° C. A specimen of this was placed in a common copper box with double sides, which serves as a steam-bath, and exposed to the temperature of boiling water. In half an hour the glass tube through which the heated air and vapour from the inside of the steam-bath escapes, was covered with a bright specular deposit of metallic mercury. From this it is clear that the metal does volatilise in considerable amount when surrounded by the vapour of water at 100°.

A New Metallic Element.—Von Kobell[5] has found a new metallic acid in various minerals—tantalite, euxenite, pyrochlore, &c.—to which he has given the name *Dianic acid*—the metal being called *Dianium*. It belongs to the same group as tantalic and niobic acids. When dianic acid precipitated from a hydrochloric solution by ammonia, is boiled with hydrochloric acid and metallic tin, a beautiful sapphire blue solution is obtained which remains after filtration. When tantalic and niobic acid are treated in the same way the solution becomes bluish, but the colour soon vanishes. When boiled with hydrochloric acid and zinc, dianic acid is

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[1] *Comptes-Rendus*, t. li. p. 94.
[2] *Pogg. Annal. der Phys. u. Chem.* Bd. cix. s. 611.
[3] *Comptes-Rendus*, t. li. p. 249.
[4] *American Journ. of Science and Art*, vol. xxx. p. 124.
[5] *Bull. der Baierisch. Akad. der Wissenschaft.* March, 1860.

precipitated blue, and is decolorised by water without being sensibly dissolved. When the freshly precipitated acid is boiled with dilute sulphuric acid, the milky liquid poured into a glass and a few grains of distilled zinc thrown in, the dianic acid in a few moments becomes dark blue, and keeps the colour for some time after the addition of water, but filters colourless. Under the same circumstances tantalic acid becomes pale blue, but loses the colour immediately on the addition of water. The above tests serve to distinguish the new acid from tantalic and niobic acids.

II. ORGANIC CHEMISTRY.

The Essential Oil of the Citrus Lumia.—The Citrus Lumia, or sweet lemon, is common in Sicily and Calabria. In external appearance very like the common lemon, the fruit differs by containing a sweet instead of an acid juice. The odour of the rind differs too from that of the common lemon, and also from the orange; it resembles bergamotte, but is not so powerful. The oil is prepared at Squillace, in Calabria, by pressing the rind of the fruit. It has a very deep yellow colour, but, when distilled, the colouring matter remains in the retort. The first portions distil between 130° and 180°, and they contain water; the greater part passes between 180° and 190°; at a higher temperature vapours with an empyreumatic smell come over. The residue, and the first portion which passes, contain oxygenated compounds. M. de Luca[6], from whose paper we quote, has made the following experiments with the portion which, on rectifying the oil, passed exactly at 180°. It is lighter than water, and insoluble in it, but on agitating imparts its smell. It is slightly soluble in alcohol, and freely so in sulphide of carbon and ether. It turns the plane of polarisation to the right. Its sp. gr. at 18° C. = 0·853. The composition is represented by the formula $C_{20}H_{16}$. Mixed with alcohol and nitric acid it becomes hydrated, and in time furnishes a crystalline matter. Heated with nitric acid, nitrous vapours are given off and yellowish resinous matters are produced. Dry hydrochloric acid gas, as well as a concentrated solution of the same acid, act on it at the ordinary temperature, and furnish liquid and crystallised compounds, the crystallised compound being a bihydrochlorate, $C_{20}H_{16}2HCl$, for it contains about 34 per cent. of chlorine.

Electrolysis of a Mixture of Alcohol and Nitric Acid.—MM. d'Almeida and Dehérain mixed three volumes of alcohol with one volume of nitric acid, and placed the mixture in a retort adapted to a receiver, and furnished with two plates of platinum, which were connected with five large Bunsen's cells. As soon as the communication was made, a large quantity of gas was disengaged at the negative pole, but none appeared at the positive. The oxygen which ought to have been given off was completely absorbed, at all events during the first hours of the electrolysis. An ethereal liquid condensed in the receiver, in which the authors proved the presence of aldehyde and acetic ether. They believe also that they found formic ether. The authors state that the nitric acid alone is decomposed by the electricity, but the direct or secondary products of this decomposition react on the alcohol. Nitrogen itself acts on the alcohol, and the liquid left in the retort was found charged with ammonia.

LABORATORY MEMORANDA.

Lubricant for Bullet Envelopes.—A mixture of one part of paraffine with one part of the volatile oil separated from Rangoon tar, and known as "Belmontine oil," "liquid gas," &c. is admirably suited for lubricating bullet envelopes. It is completely decomposed into carbon and hydrogen when the piece is fired, leaving no residue. It is best applied by saturating the paper or linen in which the bullet is wrapped in the same manner as in preparing waxed paper. I believe that a mixture of paraffine with caoutchouc and some other substances has also been employed for this purpose.—*Harry Napier Draper, F.C.S.*
Dublin.

[Dr. Scoffern has patented the mixture of caoutchouc, paraffine, and napthaline. See CHEMICAL NEWS, Vol. i. p. 10.]

[6] *Comptes-Rendus*, t. li. p. 258.

MISCELLANEOUS.

The Indiscriminate Sale of Poisons.—An inquest was held at the Maid and Magpie public-house, Stepney, before Mr. Humphreys, coroner, and a jury, on the body of Mrs. Rebecca Stephens, a widow, aged 37, who committed suicide by swallowing a quantity of oxalic acid. The deceased sent her son, a boy of eight years old, to a distant shop to purchase some oxalic acid; but when the boy returned the mother was found to be dead, having poisoned herself with some oxalic acid she had previously procured. At the inquest the jury expressed a very strong opinion that chemists and druggists were highly culpable in selling dangerous poisons. The deceased had been provided with several doses of oxalic acid before she sent the boy for another parcel on Tuesday morning. It was monstrous that chemists and druggists should be permitted to sell deadly poisons to children. The coroner agreed in all that had fallen from the jury. This was a matter of the deepest importance to the public at large. He should impound the oxalic acid on the table, and adopt some further proceedings in the matter. The jury then returned a verdict that the deceased committed suicide, and was of unsound mind when she committed the act.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

J. B.—Precipitate camphorate of lead, and then decompose it by means of sulphuretted hydrogen. Filter, and evaporate the filtrate to dryness. Redissolve the camphoric acid in alcohol, and allow the solution to evaporate slowly.

A Constant Reader writes, "Can any of your numerous readers say which is the best method of changing the blue or violet aniline dye to the rose?"

W. G.—There is no book on the subject in English.

Phar.—1. An alcoholic extract must be meant. 2. By maceration or percolation. We prefer maceration, if care be taken to shake the mixture at least twice a day.

Received.—*J. A. Davies.*

"*The Writer of the Paper referred to.*"—In type, and will appear next week.

Chemicus.—Next week.

Vol. I. of the CHEMICAL NEWS, containing a copious index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

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CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnmdon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, BAILLIÈRE, 219 Regent Street, London.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Sources of the Nitrogen of Plants, by Dr. CHARLES A. CAMERON, *M.R.I.A. F.C.S. Prof. of Chemistry, &c.*

PREVIOUS to the year 1857, our knowledge of the sources of the most important (agronomically considered) of the *organic* constituents of the food of plants—*nitrogen*—was limited to the following substances:—

Ammonia and its Salts.
The Nitrates of the Alkalies.
The Cyanides of Potassium and Sodium.

These substances have been proved, beyond all doubt, to be capable of furnishing nitrogen to plants; but there are other bodies whose capability of supplying this element to vegetables is still a *quæstio vexata*. These bodies are free nitrogen—that gas which forms the most abundant constituent of the atmosphere, and the nitrogenous organic matter termed *humus* (the altered remains of plants), a substance which is present in every fertile soil.

There are, I believe, but few vegetable physiologists who now insist that plants are capable of assimilating uncombined nitrogen; but many of the most celebrated investigators of phyto-chemistry, whilst admitting that plants derive a large proportion of their nitrogen from the ammonia of the atmosphere and the soil, maintain that the greater proportion is furnished to them by the soluble organic matter of the soil. For my own part, I have satisfied myself, by numerous carefully conducted experiments, that neither the free nitrogen of the atmosphere nor the combined nitrogen of humus can be assimilated by plants. I have further satisfied myself that the nutriment of plants can only be supplied by substances of a purely inorganic nature[1], under which designation I include a considerable number of substances—such as ammonia and urea—which are commonly, though, as I believe, incorrectly, considered as pertaining to the organic kingdom. Some of the results of my researches in this domain of science have been published in various journals[2] since 1857. These researches prove that the sources of the nitrogen of plants are not limited to the substances above enumerated; but that in addition to these, UREA and the CYANURATES of POTASH and SODA, compounds exceedingly rich in nitrogen, are capable of yielding that element to growing plants. Since the publication of these experimental results, I have occupied myself in investigating still further this interesting subject, and I have now to announce the addition of two substances to the list of those capable of furnishing nitrogen to plants, namely, NITRITE of POTASH and FERROCYANIDE of POTASSIUM. The experiments by which I succeeded in proving the availibility of these bodies, as food for plants, were conducted in the following manner:—

A number of peas were selected, some of which were dried, submitted to analysis, and found to contain 4·365 per centum of nitrogen. Others were sown under the following circumstances: five earthenware vessels, respectively labelled Nos. 1, 2, 3, 4, and 5, were partly filled with brick dust, and in each were sown eight peas. These were manured with a mixture composed of the following ingredients:—The double silicate of potash and soda, chloride of sodium (common salt), carbonate of lime (chalk), hydrated sulphate of lime (gypsum), freshly precipitated phosphates of lime and magnesia, and calcined bones. In addition to this compound, which, it will be perceived, was altogether destitute of nitrogen, Nos. 1 and 2 were supplied with ferrocyanide of potassium, and Nos. 3 and 4 with nitrite of potash.[3] Both of these substances are well known as nitrogenous compounds. No. 5 was left without any nitrogenous substance. The vessels were placed under glass shades, and supplied with sufficient light, and with air freed from the slightest trace of ammonia or of nitric acid.

The seeds were sown on the 28th of March 1860, and with three exceptions, germinated and developed into plants. Daily, during the growth of the plants, they were supplied with carbonic acid, both in the gaseous state and dissolved in water.

On the 24th of May, the following results were observable. With one exception, the plants in Nos. 1 and 2 had attained to a fair size, and looked healthy; and with two exceptions the same may be said of the plants in Nos. 3 and 4; all the plants were in flower. In No. 5 the result was different; the seeds had germinated, and the plants grew favourably for a short time, but, at the period above-mentioned, presented small, sickly, and decaying haulms, and no appearance of flowers.

On the 12th of July the plants to which the nitrogenous substances were supplied had perfectly matured their seeds; whilst those grown with the non-nitrogenous manures had withered away, after attaining a stunted stature, and without having made any attempt at maturation. I may here remark that the peas grown under the circumstances thus described were not what would be considered good by a market gardener, and there was but a poor return for the seed. My object, however, was not to grow a good leguminous crop, but merely to endeavour to extend our knowledge of the nature of the food of plants.

Some of the plants—straw and seed—grown in Nos. 1 and 2, were analysed, and were found to yield an amount of nitrogen which, compared to that contained

[1] Many eminent chemists have endeavoured to prove that a portion of the food of plants is furnished directly by the soluble organic matter of the soil. Amongst them may be mentioned De Saussure, Berzelius, Boussingault, Hermann, Payen, Mulder, and Soubeiran. Liebig, on the contrary, maintains that the food of plants is wholly inorganic; and if under the head of inorganic bodies, *teleoxidic* substances, such as urea, be included, I am altogether disposed to accept Liebig's *mineral theory*, as it is termed, in its entirety.

[2] See "On Urea as a direct Source of Nitrogen to Vegetables," *Report of the British Association for* 1857; and the *Journal of Agriculture*, Edinburgh, for October 1857; "Some Views on Vegetal Nutrition," *The Chemist*, for November, 1858; and the *Monthly Agricultural Review*, No. 9. vol. i.; "On the Respiration of Plants," *Weekly Agricultural Review*, No. 31. vol. i.

[3] This salt was prepared by heating nitrate of potash to redness: but care was taken to free it, in the way suggested some years since by Fischer, from the slightest trace of the nitrate.

in the original seed, was as 38 to 1. The nitrogen in the plants grown in Nos. 3 and 4 was found to be greater in quantity—in the proportion of 34 to 1—than that contained in the original seed. This increase, which could only have been derived from the nitrogen in the yellow prussiate of potash, and nitrite of potash, proves that these substances should be added to the list of materials capable of being used as a nitrogenous food by plants.

I intended to try some experiments this year with reference to sulphocyanide of potassium, and uric acid, as sources of nitrogen for plants, but the want of a sufficient number of large glass shades, and the peculiarly constructed vessels attached to them, which I employ in these experiments, obliged me to abandon my intention so to do for the present. Sulphocyanide of potassium, like the ferrocyanide of the same base, is innocuous, rich in nitrogen, and very soluble. Uric acid contains a larger proportion of nitrogen, but is very sparingly soluble. I have no doubt that both substances will be found capable of ministering to the wants of vegetable life. It is also probable that ferricyanide of potassium is capable, like its kindred substance, the yellow prussiate, of rendering up its nitrogen on the demand of the plant.

On Cespitine, and other Bases produced by the Destructive Distillation of Peat, by Arthur H. Church *and* Edward Owen.

(*Concluded from page 134.*)

An attempt to prepare the bichloride of plato-cespityl-ammonium, for so we provisionally name the salt just described, by the direct union of cespitine and bichloride of platinum, led to no definite result. The bichloride of plato-cespital-ammonium is not altered by continued ebullition, but may be crystallised from boiling water.

The metamorphosis of the platinum salt of cespitine pointed to an essential difference between that base and amylamine; and this difference is the more remarkable, since the true amylamine has been detected by Greville Williams and by Anderson among the products of the destructive distillation of several organic substances. An experiment was made, however, in order to establish this distinction more conclusively. One volume of pure cespitine was digested in a sealed tube at 120 C. for several days with 8 or 10 volumes of iodide of ethyle. On opening the tube no escape of hydriodic acid gas occurred, but on shaking up its contents with water, and evaporating the aqueous solution, a syrup was obtained which did not show the least tendency to crystallise even in vacuo over sulphuric acid; the iodide of ethyl-amyl-ammonium is crystallisable. On the addition of oxide of silver to this syrup after it had been diluted with water, an alkaline and caustic liquid was obtained, but no volatile base separated; had the cespitine been in reality amylamine, ethyl-amylamine should have been formed, together with other bases containing more ethyle. But no such substitution had taken place; the cespitine, being a nitryle base containing no hydrogen thus replaceable, had merely combined with one equiv. of iodide of ethyle to form a salt. The alkaline solution of the ethyle derivative was now neutralised with hydrochloric acid, and precipitated with bichloride of platinum; a buff coloured curdy precipitate was formed, which, when washed and then recrystallised from warm water, yielded very voluminous micaceous plates of a straw colour. These crystals were almost insoluble in cold water. The following numbers proved them to be the platinum salt of ethyl-cespityl-ammonium:—

	Experiment.	Theory, $(C_{10}H_{13})'''$, $C_4H_5,NCl,PtCl_2$.
Platinum	. 30·73 .. 30·69 .. 30·23 .	. 30·79

When cespitine is acted on by iodide of amyle, a yellow uncrystallisable gummy mass is obtained, the iodide of amyl-cespityl-ammonium $(C_{10}H_{13})''', C_{10}H_{11}, NCl, PtCl_2$, very different from the isomeric body, the crystalline iodide of diamyl-ammonium, produced by the action of iodide of amyle on amylamine. And when this iodide was acted upon by oxide of silver, and the hydrate thus produced combined with hydrochloric acid, an excessively soluble chloride was obtained, which did not exhibit a trace of crystallisation when evaporated to dryness, and had, in fact, no character in common with that of the highly crystalline and difficultly soluble chloride of diamyl-ammonium.

Cespitine is isomeric not only with amylamine, but also with diethylmethylamine and dimethylpropylamine; and since it has been found to contain no replaceable hydrogen, it seemed probable that it might be one of the nitryles just mentioned. But cespitine is entirely unacted upon by nitrous acid, not a trace of any alcohol being produced. All our experiments with cespitine lead us to believe that it bears the same relation to the true amylamine as picoline does to aniline.

Cespitine is a colourless oil, less fluid than water, and miscible in all proportions with that liquid. It is nearly insoluble in a saturated solution of caustic potash. It boils at about 95°, the boiling point of amylamine its isomer. It is lighter than water; its odour is powerful, and although slightly unpleasant, much less so than amylamine. It precipitates many metallic solutions; with sulphate of copper it gives a green precipitate, soluble in excess of the base with a *pale green* colour. With chloride of mercury a beautiful pearly substance is deposited in iridescent scales. The platinum double salt has been already described: the gold salt is a pale yellow crystalline powder. The cadmium double salt is very soluble, but it may be obtained in long colourless prisms by mixing strong solutions of hydrochlorate of cespitine and chloride of cadmium, and then evaporating the liquid over sulphuric acid.

Pyridine.—It will be seen from our further examination of the bases from peat, that they are identical in composition with pyridine and its homologues. And since we have not thought it necessary to describe them minutely, we may here state that their properties, physical and chemical, correspond closely with those of pyridine, picoline, &c. as recorded by Anderson.

The boiling-point assigned to pyridine is 116°5. The few drops of base which distilled near this point, coming over in the 8th rectification between 110° and 120°, were converted into the hydrochlorate, and precipitated with an insufficient quantity of bichloride of platinum: this first crop of platinum salt gave the following result when burnt:—

	Experiment.	Theory—Pyridine.
Platinum . . .	34·50	34·68

The filtrate from the pyridine salt yielded another crop of crystals on the addition of more bichloride of platinum; the amount was, however, insufficient for an analysis.

The pyridine platinum salt yielded pale yellow flocks of the bichloride of plato-pyridyl-ammonium after having been boiled with water for forty-eight hours.

Picoline.—Between 130° and 140° rather more than 70 grammes were obtained in the 9th rectification; pico-

line is said to boil at 135°. This fraction proved to be pure picoline. Converted into a platinum salt and burnt it gave 33·01 per cent. platinum.

Between 140° and 140° 100 grammes distilled over, and, like the preceding fraction, were pure picoline. Three successive crops of the platinum salt fractionally precipitated, gave the following percentages, — 32·97, 32·98, 32·95.

The platinum salts of the next fraction gave slightly different numbers, indicating a mixture of picoline and lutidine. The oil had been collected between 145° and 150°, and amounted to not less than 60 grammes. The following percentages are those of the various crops compared with the theoretical percentages required by picoline and lutidine :—

Experiment.										Theory.	
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	Picoline.	Lutidine.
33·01	32·97	32·98	32·95	32·81	32·98	32·89	32·00	32·03	31·47	33·06	31·58

The quantity of pure picoline at our disposal has induced us to experiment further upon it, in order to obtain some insight into its true constitution. By the action of the bichloride or the bibromide of ethylene upon picoline, we have obtained salts of an ammonium which is remarkable for the beauty of many of its compounds. The reaction, which takes place readily when the materials enclosed in a sealed tube are heated to the boiling-point of picoline proceeds thus :—

$$2[(C^{12}H^{7})'''N] + (C^{4}H^{4})''Cl^{2} = (C^{12}H^{7})'''^{2}(C^{4}H^{4})''N^{2}Cl^{2}.$$

Two equivalents of picoline have thus been united into one molecule by means of the diatomic group ethylene : at the same time hydrochlorate of picoline and other compounds appear to be formed, but only in small quantity. The details concerning several new derivatives of the pyridine bases are reserved for another communication.

Lutidine.—The fraction 150° to 155° was not examined. The fraction 155° to 160° amounted to 60 grammes, and consisted of pure lutidine, the boiling point of which is 154°. The percentages of metal in the platinum salt agree well with theory 31·33 and 31·40.

A portion of the base which distilled over in the 8th rectification between 160° and 165°, gave a platinum salt which on ignition furnished the following numbers : it had been recrystallised from alcohol, was a very beautiful salt, and gave 31·31 and 31·32 per cent. of platinum when burnt.

These platinum salts, which were of a deep orange colour and highly crystalline, occurring in very regularly flattened square tables, corresponded almost exactly with the lutidine platinum salt as described by Anderson, but seemed to be rather less soluble in cold water.

Below the four foregoing per centages of platinum are compared with that of lutidine :—

	Experiment.				Theory. Lutidine.
Platinum .	31·33	31·4	31·31	31·32	31·58

The fraction 165°—170° gave indication of the presence of the next higher homologue of lutidine when the platinum salts fractionally precipitated were ignited. The percentages were as follows :—

31·52 30·97 30·37

The percentage of platinum in the last of these salts is almost exactly the same as that in the salt of collidine, which contains 30·23 per cent. platinum.

Collidine.—The fraction 170°—175° was a mixture of lutidine and collidine, while the liquid that distilled between 175°—180°, 180—185°, 185—190°, were nearly pure collidine, which is stated to boil at 169°. The three annexed determinations were made with the platinum salts obtained from these three fractions :—

I. 0·4162 grm. gave 0·1256 grm. platinum = 30·17 p. c.
II. 0·383 grm. gave 0·1153 grm. platinum = 30·10 p. c.
III. 0·354 grm. gave 0·107 grm. platinum = 30·22 p. c.

Experiment.			Theory.
I.	II.	III.	Collidine.
30·17	30·10	30·22	30·23

The largest quantity of collidine distilled over between 180° and 186° ; altogether about 200 grammes were collected. The entire absence of aniline from the peat bases was proved by several careful qualitative experiments, while the platinum determination made with the salt of the 180°—185° fraction (III. above) gave a percentage differing from that of the aniline salt by as much as 2·84 per cent. In this fraction, aniline, the boiling-point of which is 182°, should have been found had it been present.

The examination of the fractions above 190° and up to 210, has not led to any very definite result. Not only are the oils above this point difficult of combustion, but they are not capable of furnishing crystalline salts. Concentrated hydrochloric solutions of the various fractions which came over in the 10th rectification between 190° and 215°, gave no precipitate with a strong solution of bichloride of platinum, even after the addition of alcohol and ether; nor could any double compound be prepared, either with the chloride of uranyle or of cadmium. The compounds produced with sulphuric and oxalic acid are colourless gummy masses. But all the fractions give with chloride of gold a bright yellow precipitate, which quickly collects at the bottom of the vessel as a brownish-yellow heavy oil. This oil is slightly soluble in water, and perfectly soluble in a mixture of alcohol and ether. Two specimens of this gold salt were prepared and the gold determined. The first determination was made with a salt obtained from the fraction boiling between 202° and 205°, which after washing with water was dried *in vacuo* over sulphuric acid until constant, for otherwise gold was reduced at a very slight elevation of temperature. The second determination was made with a salt similarly prepared from the fraction 205°—208°, but it had been dissolved in a mixture of alcohol and ether. These fractions were those of the 10th rectification.

Translated into percentages, the numbers obtained correspond with the proportion of gold required by a gold salt of parvoline ($C^{16}H^{13}N$) containing four equivalents of water :—

Experiment.		Theory. $C^{16}H^{14}NCl,AuCl_3 + 4$ Aq.
38·60	38·46	38·55.

The unpromising character of the salts of these fractions has, however, deterred us from making further experiments with them.

Between 210° and 230° the quantity of distillate was but small, and we have as yet gained no insight into its constitution. From 230° to 280° or 290° several grammes of a thick brownish oil came over; these fractions yielded crystalline platinum salts; it is very probable that they contain chinoline and its higher homologues, lepidine and cryptidine, bases discovered by Greville Williams among the products obtained by the destructive distillation of cinchonine.

The following formulæ are those of the new compounds described in the present memoir :—

Cespitine	$(C^{10}H^{13})'''N$.
Chloride of cespityl-ammonium	$(C^{10}H^{13})'''HNCl$.
Platinum salt of cespityl-ammonium	$(C^{10}H^{13})'''HNCl,PtCl^2$.
Bichloride of plato-cespityl-ammonium . . . ;	$(C^{10}H^{13})'''PtNCl^2$.
Chloride of amyl-cespityl-ammonium	$(C^{10}H^{13})'''C^{10}H^{11}NCl$.
Chloride of ethyl-cespityl-ammonium	$(C^{10}H^{13})'''C^4H^5NCl$.
Hydrate of ethyl-cespityl-ammonium	$(C^{10}H^{13})'''C^4H^5NO,HO$.
Platinum salt of ethyl-cespityl-ammonium . . .	$(C^{10}H^{13})'''C^4H^5NCl,PtCl^2$.
Bichloride of ethylene-dipicolyl-diammonium . ;	$\left.\begin{matrix}(C^{12}H^7)''''^2 \\ (C^4H^4)''\end{matrix}\right\} N^2Cl^2$.

NOTE.—The full analytical details referred to in the present paper will be found in the *Philosophical Magazine* for the past month.

TECHNICAL CHEMISTRY.

On the Preparation of Artificial Colouring Matters with Products extracted from Coal Tar, by M. E. KOPP.

(*Continued from page* 125.)

Before rectification the oils are agitated for an hour with concentrated sulphuric acid, the light with 5 and the heavy with 10 per cent. They are then allowed to rest for 24 or 36 hours for the acid and impurities to deposit. The oil is then separated and washed once or twice with water and afterwards with a solution of caustic soda sp. gr. 1·382. For the lighter, 2 per cent. of the soda solution will be enough, but the heavier will require 6 per cent. When so purified the light oil is rectified by distillation with a current of steam. The condensed product having a mean density of ·815 to ·820, is the benzole of commerce.

The heavy oil is distilled without the assistance of a current of steam. The condensed product has a mean density of ·860, is of a clear yellowish colour similar to that of Madeira wine, and has the disagreeable odour of sulphur compounds, formed by the action of the sulphuric acid. This may be destroyed by shaking the oil before distillation with a solution of sulphate of iron, or after distillation with the addition of some caustic soda to the sulphate of iron. A blackish deposit of sulphide of iron is formed and the oil loses its bad odour.

Paraffine and the heavier mineral oils which drain from the paraffine are purified in the same way by means of sulphuric acid, which is sometimes combined with oxidising agents such as bichromate of potash, peroxide of manganese, and manganate of potash, &c. and subsequent washing with caustic soda. After the action of the acid and alkali paraffine is sometimes rectified by a second distillation, but more frequently the purification is completed by a second treatment with sulphuric acid followed by a careful washing, after which the paraffine is mixed with 1 per cent. of stearic acid, and treated with the caustic soda. The alkali by saponifying the stearic acid forms soapy flocculi which envelope the impurities and the melted paraffine is rendered perfectly limpid.

The acid and alkaline residues of the above purifying processes are generally thrown away, but in them are found the principles which may be utilised for the production of the colouring matters. The sulphuric acid, for example, must combine with all the alkaline compounds such as aniline, quinoline, toluidine, cumidine, &c.; while the caustic soda must unite with the acid principles like phenol, creosote, and rosolic acid. Vohl [1] has already proposed to extract phenol and creosote from the alkaline solution by supersaturating it with the acid solution, decanting the oily layer which separates, and rectifying it over a naked fire. A more rational process, according to the author, would be the following:—Collect all the acid and alkaline liquors, and determine how much of the acid liquor would be sufficient to saturate a given volume of the alkaline. This being known, mix the alkaline solution with twice the quantity of acid liquor necessary to saturate it. If the two be mixed rapidly sufficient heat will be developed to raise the mixture almost to the boiling-point, and a concentrated solution of bisulphate of soda will be formed which retains in solution the bisulphates of aniline and toluidine, while the phenol and creosote easily separate in form of a brown oil. This oil may be separated while the mixture is still warm, and rectified. A light neutral oil first passes, and afterwards the phenol and creosote distil almost pure.

The solution containing the acid sulphates of soda and the organic bases yields on cooling crystals of bisulphate of soda, which may be collected on a filter. The acid liquor not used to saturate the soda solution may then be added from the mother-liquor from the crystals, and the whole heated to 60° or 80° C. Chalk or milk of lime is then added to partial saturation, the sulphate of lime is allowed to deposit, and the liquor is concentrated. Finally the concentrated acid sulphates are introduced into an iron still, and an excess of quick lime is added. Sulphate of lime and some sulphate of soda are formed, the organic bases are set at liberty, and on heating they pass over and condense with some water. If the quantity of water be sufficient to hold the bases in solution, the distilled aqueous solution must be saturated with hydrochloric acid and evaporated, first over a naked fire and then over a water bath, almost to dryness. The residue placed in a retort is mixed with an excess of quick lime and distilled, when an oily liquid is obtained which consists principally of aniline, toluidine and quinoline, sufficiently pure for the preparation of the colouring matters. We shall now notice successively the compounds from which the colouring matters may be formed, and the colouring matters themselves, describing the most advantageous and best known processes for obtaining them.

1. **Aniline.**—Unverdorben first discovered aniline among the products of the dry distillation of indigo in 1826. As it formed crystallised salts with acids he gave it the name of *crystalline*. In 1840 Fritsche made anthranilic acid by introducing finely powdered indigo into a hot and strongly concentrated solution of caustic potash. One of the most remarkable properties of this acid is its splitting up into carbonic acid and aniline when distilled with quick lime.

$$\underbrace{C_{14}H_7NO_4}_{\text{Anthranilic acid.}} + 2CaO = \underbrace{C_{12}H_7N}_{\text{Aniline.}} + 2(CO_2.CaO).$$

Erdmann first observed that aniline was identical with the crystalline of Unverdorben. Hoffmann afterwards showed that to prepare aniline it was not necessary to make anthranilic acid, but that it sufficed to distil indigo directly with hydrated caustic potash, the aniline being formed in consequence of a real oxidation of the indigo.

Isatine a product of the oxidation of indigo by weak nitric acid also furnishes aniline on distillation with

[1] *Journal für Prakt. Chem.* Bd. lxxv. s. 295.

caustic potash. Runge, 1837, first announced the existence of three volatile bases in coal tar, which he named respectively kyanol, leukol, and pyrrol. Hoffmann subsequently demonstrated that kyanol, was identical with aniline, and later he proved that leukol was identical with quinoline, a base which Gerhardt had obtained by distilling the cinchona alkaloids with mineral alkalies. Another very remarkable method of forming aniline is based upon the action of reducing bodies on nitrobenzole. Zinin, by saturating an alcoholic solution of nitrobenzole with ammonia, and then passing sulphuretted hydrogen as long as any deposit of sulphur was formed, obtained an organic alkali which he called benzidam, but which was afterwards proved to be aniline.

$$\underbrace{C_{12}H_5NO_4}_{\text{Nitrobenzole.}} + 6HS = C_{12}H_7N + 4HO + 6S.$$

Bechamp showed that the reduction could be effected equally well by means of ferrous acetate or acetic acid and iron.

$$C_{12}H_5NO_4 + 6Fe + H_2O_2 + 6\bar{A} = C_{12}H_7N + 6(FeO\bar{A}).$$

Before this, however, Hoffmann had shown that nitrobenzole might be converted into aniline by the action of zinc and hydrochloric acid.

Lastly, Wöhler has discovered that nitrobenzole may be reduced and transformed into aniline by digestion and distillation with a solution of arsenious acid in an excess of caustic soda.

Amongst other methods of producing aniline we quote the following. Phenol and ammonia placed in a stout tube sealed and exposed for a long time to a high temperature from aniline.

$$\underbrace{C_{12}H_6O_2}_{\text{Phenol.}} + NH_3 = C_{12}H_7N + 2HO.$$

According to Hoffmann and Muspratt nitrotoluene and salicylamide, two bodies isomeric with anthranilic acid, furnish aniline when heated to redness.

$$\underbrace{C_{14}H_7NO_4}_{\text{Nitrotoluene.}} = C_{12}H_7N + 2CO_2.$$

Of all the methods, however, two only appear to serve as industrial processes:

1. Extraction from coal tar.
2. Reduction of nitrobenzole.

On the Presence and Effect of Arsenic in Dale's Patent Magnetic Muriate of Iron, by F. Versmann, *and* J. E. D. Rodgers.

[The following report has been made to Mr. Dale, the patentee of the "Magnetic Muriates of Iron" in answer to Dr. Letheby's objections to the use of that fluid for the deodorisation of London sewage.]

Sir,—As there are conflicting statements between the reports of Drs. Hofmann and Frankland, and Dr. Letheby on the presence and effect of arsenic in your "Patent Magnetic Muriates of Iron," it may be of importance to you to have the matter more fully investigated. We have, therefore, according to your desire, submitted to analysis various samples of your preparation; and we now beg to submit to you the result of our investigation. The fluid is at present obtained by first making the dry muriate of iron, and then dissolving it; and we, therefore thought it advisable to analyse samples of the dry salt (Nos. I. and III.), and of the solution (Nos. III. and IV.) as obtained from the salt under the recent improvements in the manufacture, together with a sample of the old solution, as supplied to the Board of Works for experimental purposes last year.

Under Nos. I. and II. we give the amount of arsenic contained in 7000 grains (one pound) of dry salt, and the same calculated for one gallon of solution of proper strength, whereas in Nos. III. to V. the arsenic is given as per gallon of fluid only.

	Grains of White Arsenic.	
	Per 7000 grs. of Dry Salt.	Per Imperial Gal. of Fluid.
I. Dry salt, very dry . .	2·08	14·56
II. Dry salt, less dry . .	71·29	51·03
III. Solution 1·28 specific gravity		10·94
IV. „ 1·33 „ „		43·96
V. „ prepared 1859 .		83·88

The fluid was formerly manufactured by simply dissolving magnetic oxide of iron in the muriatic acid of commerce, and subsequent concentration of the solution by evaporation. It is obvious that the product thus obtained must necessarily contain all the arsenic present in the materials employed. But as in the present mode of manufacture, the solution is first brought to dryness, and is thereby exposed to considerable heat, most of the arsenic is expelled during the operation.

The numbers in the above table are sufficient proof of this assertion; because it will be seen that the driest salt contains the least arsenic; and all samples prepared in this way (Nos. I. to IV.) contain considerably less than the old solution.

In placing the results of our estimation of arsenic in the old solution against those of Drs. Hofmann and Frankland, and Dr. Letheby, we obtain the following table:—

	White Arsenic per Gallon of Fluid.
Drs. Hofmann and Frankland . . .	68·7 grs.[1]
Dr. Letheby (238 grs. of chloride of arsenic)	130· „
Versmann and Rodgers	83·88 „

The great difference in these numbers can be accounted for, only by assuming that the original solution supplied to the different analysts is not from one and the same maker; but that it must have been obtained from different materials. Dealing with such a poisonous substance, it will, of course, be necessary to accept the highest number found; and we would, therefore, here merely record the fact, that your fluid, as now prepared, contains considerably less of the poison than formerly; but we will base our subsequent comparisons upon the number of grains found by Dr. Letheby, being by far the highest.

Before proceeding to consider the possible importance of these numbers we must refer to Dr. Letheby's statement, that

"The form in which the arsenic exists in the liquid, is one of the most dangerous of all the compounds of arsenic—far more dangerous than the common white arsenic."

And we cannot do so without expressing our regret

[1] We give the corrected number 68·7 grains of arsenious acid, since 52·1 grains represented *metallic* arsenic in the Report referred to.—Ed. C. N.

that he did not deal more fairly with a question of such vast importance; and that he did not avoid the introduction of matters which are, to say the least, open to dispute.

It is well known to chemists that this most dangerous compound, the chloride of arsenic, can exist as such only in very acid solutions, or in the presence of very minute quantities of water, and that it is speedily decomposed by a large addition of water into white arsenic and muriatic acid; and as the quantity of water in one gallon of your fluid is many times larger than that required to decompose 238 grains of chloride of arsenic, we cannot well understand why the possible danger arising from the presence of arsenic should be made to appear larger still by the introduction of this compound and its poisonous properties.

Persons not acquainted with chemical facts will therefore form a wrong idea of the possible danger arising from the introduction of your deodoriser. Nor is this the whole of the error they would commit; for Dr. Letheby would lead the readers of his last report to believe that there would be a rapid and dangerous increase of the arsenic to each gallon of water in the river.

Without enteriug into the question how many times the sewage will be diluted by the water flowing down the river, we will consider the proportion of your fluid and the sewage only; because every one must admit that the water which does flow is at least sufficient to prevent concentration of the sewage by evaporation.

Dr. Letheby asserts that with your fluid a quantity of chloride of arsenic, corresponding to one cwt. and a half of white arsenic, would be thrown into the river daily; our calculations do not give that result, because from his own numbers, and from the quantity of fluid required (66 gallons to each million gallons of sewage), it should be less than one hundred pounds. This difference, however, is perfectly irrelevant, because, *according to Dr. Letheby's own data, more than four gallons of the purified sewage must be imbibed in order to incorporate one-sixteenth part of a grain of white arsenic, an ordinary medicinal dose, not unfrequently taken three times a day.*

It would, however, be incorrect to follow out this calculation, which is based upon the assumption, that the arsenic remains in solution, whereas in reality it is precipitated as soon as your fluid is mixed with the sewage. The arsenic will be found in the mud of the river, and we are at a loss to understand how any danger can arise from the unpleasant deposit, because we cannot see how it possibly could happen that any human being should incorporate so large a quantity of the mud as to feel any effect of the arsenic contained in it.

Drs. Hofmann and Frankland state that one part of arsenic is contained in about three three thousand parts of this mud; or that about two hundred grains contain the above medicinal dose; or at least one pound of this mud must be swallowed in order to take up a poisonous quantity of arsenic.

Wherever we look in nature we constantly meet with poisonous principles in small quantities, and frequently in very large quantities, but fortunately only few of them are in such condition as to act directly; most are found as compounds, from which the poisonous principle must be separated and made soluble before it can take effect; and we are convinced that any fear or apprehension of danger from arsenic in the mud of the river is just as chimerical as if we would point out the presence of arsenic in pyrites hidden somewhere in the earth.

The arsenic in the mud, independently of its infinitesimal dilution, is NOT *in a state to act as a poison;* it is an insoluble precipitate, and we therefore think that Dr. Letheby's quotations, both from Orfila and Taylor, are entirely foreign to the subject. He cites from Orfila, that the compound of which arsenic with oxide of iron is soluble in the acid secretions of the stomach; but how could this solvent power be called upon to act, seeing that at least one pound of the mud must be swallowed before danger could arise—the very possibility of which we dispute.

The same objection holds good to the quotation from Taylor because, when it is evident that no human being can take in the medium containing the poison, it is useless to speak of the relative power of an antidote.

In going over Dr. Letheby's reports, we can come to one conclusion only, namely, that he must be highly prejudiced against the introduction of your fluid, all his arguments bearing unmistakeable signs of a biassed opinion. It certainly has been shown, by sufficiently long experience, that your fluid is NOT useless and expensive, as again stated by Dr. Letheby; and it certainly cannot, and will never, favour the commission of crime. It is only of late that the presence of arsenic in a great many waters has been ascertained; and if additional proof were wanted to show that waters containing small quantities of arsenic are constantly used for domestic purposes, and without any harm, we might refer to a note on the *Arsenical Waters of Whitbeck, Cumberland,* by Mr. Church, as given in the CHEMICAL NEWS of the 25th instant.

Mr. Church says that this water contains a good fraction of a grain of metallic arsenic per gallon, that it is habitually used for every purpose by the inhabitants of the little village of Whitbeck with beneficial rather than injurious effect.

This wholesome water, then, contains per gallon a good fraction of a grain of metallic arsenic; whereas, purified sewage will contain per gallon less than one hundredth part of a grain of white arsenic, suspended with the mud, as an insoluble precipitate.

That water is habitually used for every purpose; but who is likely to use or drink the sewage water, as discharged into the river? That question we are not prepared to answer.

If it were necessary to adduce additional proof of the harmless condition of the sewage water, after being treated with your fluid, we would state that we have seen fish in a perfectly healthy condition, after having been kept for months in such water.

We would, in conclusion, particularly call your attention to the fact that this controversy has originated simply with the impure condition of the fluid as originally manufactured; and that it cannot bear upon the patent fluid as now brought into the market.

The analyses of Nos. I. and III. in the above tables, show that your fluid can be prepared to contain so little arsenic as to leave no room for any objection, even on the part of the most imaginative.

On former occasions it has been shown that your fluid is the best, the most effective, and the least expensive of all known deodorisers and disinfectors; and we can have no hesitation in declaring that the arsenic contained in it cannot, and will not, become an obstacle to its general application.—We are, &c.

FRED. VERSMANN, F.C.S.
J. E. D. RODGERS,
Formerly Lecturer on Chemistry at St. George's School of Medicine.

PHARMACY, TOXICOLOGY, &c.

Note on Persian Opium, by Dr. O. Reveil.[1]

Persian opium, which for many has been but seldom met with in commerce, is now becoming more abundant; it is important therefore to decide on its value as a medicine, and the place which it ought to occupy in therapeutics, as well as the uses which may be made of it in pharmacy.

Persian opium is imported in the form of thin cylindrical sticks four or five inches long, which sometimes become flattened by pressure one against the other. Each stick is wrapped in white or rose-coloured paper, and tied with cotton. The weight of each stick is about fifteen grammes. Guibourt has remarked that the paste, although apparently homogeneous, is seen when cut into to be made up of small lumps agglutinated together, the lumps being much smaller than those seen in Smyrna opium. It is of a reddish-brown or liver colour, has a strong smell, a very bitter taste, is slightly hygrometric, and is very soluble both in water and alcohol. One sample (in sticks), analysed by the author, yielded the following results:—

Matters soluble in water		82·60	per cent.
„ „	alcohol	81·60	„
Alkaloids 12·30	morphia	8·15	„
	narcotine	4·15	„

The aqueous solution of this opium treated with anhydrous alcohol gave a flocculent precipitate. When treated with the tartrate of potash and copper the cupric salt was reduced, proving the presence of sugar, a fact which was confirmed by the fermentation test. Estimated by a standard cupro-potassic solution, it was found that the sample contained 15 per cent. of glucose. The author has never detected sugar in Constantinople opium, but has sometimes discovered notable quantities in that imported from Smyrna. The presence of this body appears to him an indication of falsification, for he has never found any in the opium made in France.

Another sample of Persian opium received by the author presented quite a different form. It was in the shape of flattened ovoid lumps without envelope either of paper of poppy leaves, nor did it contain any seeds of the rumex such as is seen in Smyrna opium.[2] The physical characters, apart from the form, closely resembled those of the preceding. It was somewhat softer, however, and perhaps more hygrometric. It mixed easily with water and alcohol. The solution blackened with potash, and it reduced the cupro-potassic tartrate. In this sample the author found 31·6 per cent. of glucose. The results of an analysis were as follows:—

Matters soluble in water		84·20	per cent.
„ „	alcohol	80·60	„
Alkaloids 12·0	morphia	6·4	„
	narcotine	5·6	„

In another specimen the author found 13·9 per cent. of sugar. When ammonia was added to a solution of this opium a very abundant yellowish white gelatinous precipitate was obtained; absolute alcohol also gave a flocculent precipitate. Ordinary alcohol almost entirely dissolved this sample giving a thick viscous liquid, which when pressed through a cloth left but a small residue: on filtration through paper a more abundant residue was obtained. The results of the analysis of this specimen were as follows:—

Matters soluble in cold water		76·5	per cent.
„ „	alcohol	93·7	„
Alkaloids 16·15	morphia	7·1	„
	narcotine	9·05	„

Another sample differed essentially from the foregoing. It was also in flattened lumps, but was enveloped in a leaf which the author could not identify. He also remarked some fruits of a rumex in it. In colour and smell it resembled the others; but it mixed less easily with alcohol and water. The solution blackened with potash, and the cupro-potassic test showed the presence of 31·6 per cent. of sugar. Analysed like the preceding the following results were obtained:—

Matters soluble in water		79·20	per cent.
„ „	alcohol	75·60	„
Alkaloids 15·0	morphia	5·10	„
	narcotine	9·90	„

All these opiums appear to the author very remarkable for their very great purity, or rather for the almost complete absence of foreign matters insoluble in alcohol and water. But their light colour, and the relatively very large proportion of narcotine and glucose which they contain incline him to assert that they are not natural products, but opium, to which some narcotine and the pulp of apricots have been added. He sees no objection to the use of Persian opium when opium is prescribed alone, but believes it ought not to be substituted in the preparation of extract and tincture, because of the smallness of the residue left. On this account an extract prepared with Persian opium will be less rich in alkaloids than one made from Smyrna or Constantinople opium, even though these latter may only contain 6 per cent. of alkaloids.

In a report presented to the Academy of Medicine of Brussels, M. Victor Pasquier makes the following observations:—

"It is to be remarked that we should greatly err if we laid it down as a general and absolute principle that an opium richer in morphia than another ought always to be preferred to the latter for all pharmaceutical preparations of which it may form the base; it may be, on the contrary, not only that an opium less rich in morphia ought to deserve the preference, but that one more strongly charged with the alkaloid would not even serve the same purpose."

This passage is made clearer by the following note, which is quoted from the *Journal de Pharmacie d'Anvers*, April 1860. Suppose, for example:—

An opium A containing morphia	4·50	per cent
„ B „ „	3·73	„
The opium A gives an ext. containing morph.	6·32	„
„ B „ „ „	8·29	„
„ A gives extract weighing	68·00	„
„ B „ „	45·00	„

From which it appears that in selecting an opium for some pharmaceutical preparations it is necessary to take into account not only the proportion of morphia contained in opium, but also the solubility of the various principles of opium in the different menstrua with which we act on it.

In the estimation of morphia, the author recommends the use of chloroform to separate the narcotine, and then cautions the experimenter against reckoning as morphia all that is soluble in alcohol after the separation of the

[1] Slightly abridged from *Journ. de Pharm. et de Chim.* Aug. 1860.

[2] We have received Persian opium in this form from Mr. Maltass of Smyrna, who informs us that the opium is never imported in this state. The cylindrical sticks are made into lumps of this shape in France.—Ed. Chem. News.

morphia. Without this precaution, he adds that one is apt to estimate as morphia what is merely phosphate of lime, or ammoniaco-magnesian phosphate when the precipitate has been effected by ammonia.

There is no doubt that at the present time opium is manufactured of opium residues, to which various extractive substances and some narcotine is added. Some specimens examined by the author, which presented none of the characters of good opium of commerce, contained 7·6 per cent of alkaloids, composed of 2·1 morphia and 5·5 narcotine.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture IV. *On Earthquakes.*

(*Concluded from p. 140.*)

Of the various regions in which earthquake action is generally most intense I may mention in Europe the south of Italy, the island of Iceland, and the Atlantic coast of Portugal. In Asia, the shores of Asia Minor, the north-west and north-east extremities of India, the coast of Siam, the line of islands in the Indian Archipelago, and the islands of China to the Arctic Sea. In America there is a very important earthquake range, all the way down the west coast to the north-western point of South America, branching off at Central America to the principal West Indian islands. The bed of the Atlantic is remarkable for intense earthquake action within certain limits. So much then for the distribution in space.

Passing on from the distribution of earthquakes in space, let me next point out the facts with respect to their distribution in time. The whole number of recorded earthquakes upon which any dependence can be placed amounts, at present, to somewhere near 7000. (This calculation is made only up to 1850, and there have been several since.) Of these 7000 we know actually the dates of a large proportion, that is, the time of the year when they take place. The whole number recorded up to 1500 is 787 only. During the three following centuries, that is, from the beginning of the sixteenth century to the end of the eighteenth century, there were 2804, four times as many as in all previous time. The whole number recorded since 1800 down to 1850 is 3340. We may conclude that 3240 in half a century is the nearest approximation as to numbers that we can at present obtain. From this then we may calculate our average, and we find that certainly more than one earthquake takes place every week on some or other of the visited parts of the earth. Of those, however, not more than one in every forty on an average are of great importance. An important earthquake occurs, therefore, about once in every eight months, and we understand by this a disturbance of considerable magnitude, capable of doing much mischief if it occurs near human habitations. Such, at any rate, has been the average of the first half of the present century, even without making allowance for those numerous cases which must have happened although we have heard nothing about them.

If, however, we take the statistics as far as Europe only is concerned we shall find that during the last ten years, or rather during a period of ten years in which calculation was made very carefully (from 1833 to 1842 inclusive) 33 earthquakes occurred on an average in every year. In other words in these ten years there were 320 distinct earthquakes in Europe only; and therefore in Europe only an earthquake occurs every nine days. It is evident that the records for other parts of the world will be much less perfect than those of Europe, and that the number generally may be far greater than is above stated. This result is startling, and I confess I was not prepared for it when the evidence came before me.

There are some very curious inquiries with regard to the special times of the year when earthquakes occur. This is a result which was not considered probable when the statistics were first commenced some eighteen years ago. It was not then imagined that there could be any relation between the occurrence of earthquakes and the season in which they occurred, but having ascertained the facts, and arranged all the recorded earthquakes in which the date of the month was mentioned in order of months the result arrived at was very extraordinary. The largest number per month was found to have taken place during the month of January, and this number was nearly one half greater than in the minimum month of July. It appears therefore that January and July stand at the extremities of the earthquake list. The total number in January was 627 the total number in July was 415. In the month of February the number was found to be 539, and in the month of October 516. These three months average considerably more than 500 each. Of the other months in the year none except March had more than 500, and the others less.

When we carry on the calculation we come to results which are thus represented: during the months of January, February, and March, the numbers run in this way—January 627, February 539, March 503, total 1669. April, 489, May 438, and June 428, total 1355. July 415, August 488, and September 463, total 1366. Almost exactly the same as April, May, and June. Finally we have October 516, November 473, and December 500, total 1489, larger than the spring and summer months, but not so large as the winter months.

When we put these results in another form and add together all the earthquakes that have occurred during the warm and cold seasons respectively, we shall find that we have had 2721 during the warm months, and during the cold months 3158. So far then it appears that the proportion of earthquakes which occur in cold weather is very much larger than those which occur in warm weather. It may, however, be supposed that this is the result of bringing together a large number of heterogeneous groups of figures which admit of other interpretation if taken separately; but if we take Europe by itself as one country we shall find that of all recorded (2020), the number of earthquakes in cold weather is 1091, and in warm weather 919. Taking each country separately we also find the same result. In the British Isles the number being 217, 123 occurred in the cold weather, and only 94 in warm. In France we have 395 in cold weather, and only 272 in warm. In Italy 538 in cold, and 455 in warm weather. In Iberia 114 in cold, and only 87 in warm weather. So that there is not a single country or group in the same result does not separately appear, and a very remarkable result it is. What it points to it is impossible to say at present, but there it is.

In the southern hemisphere the law seems similar, the excess having no relation to the months, but only to the seasons. The excess of earthquakes appears in all cases to be in cold weather. It has been thought, again, that the position of the sun and moon might affect the occurrence of earthquakes, and M. Perrey of Dijon calculated the number during the time of what are called the critical periods of the year—the equinoxes, and the summer and winter solstice. Thus he finds that in the autumn equinox month (September and October) there were 164, and in the spring (March and April) 151, with but little difference of temperature. In the winter solstice (December and January) there were 177, and in the summer (June and July) only 129, with a great difference of temperature. The remaining earthquakes of the year distributed over the other four months showed a very much smaller average than any of the others.

Other curious results were made out with regard to the position of the moon, and some of them seemed to point to conclusions of which at present it is hardly safe to speculate.

Taking next the intervals of earthquakes and the periods of

chief action it appears that these have latter happened on the whole about once in every century. Occasionally, however, intervals of two centuries have elapsed without first class movements. During three successive centuries there have been perhaps two great series of earthquakes. These very serious movements have taken place generally in the middle of the century. With regard to second class earthquakes they have generally occurred in groups, several together, during the latter part of those centuries marked by great disturbances. In other respects and with regard to ordinary earthquakes if the interval has been large the earthquake was considerable, but if small the earthquakes have been less important.

You may ask what do all these conclusions point to? What general results of observation may we depend upon in reference to earthquake movements, and what are the probable results to science and ourselves. I will endeavour to recapitulate these so as to impress them on your memories.

First, then, earthquakes must be regarded as the undulations produced by the exercise of some great expansive forces acting beneath the earth's surface on tolerably well defined zones, whenever such expansive force rapidly breaks asunder instead of quietly and slowly heaves up the vast weight of overlying earth and sea that intervenes between its point of action and the upper surface. The convulsive or paroxysmal movement thus occasioned by the fracture of rocks at a great depth generally causes an earth wave to be propagated to a distance which is proportioned to the amount of force exercised and the depth at which it acts, and not unfrequently opens out a communication to the surface and terminates in a volcanic eruption. After one great wave is thus formed and sent on it is often repeated before it quite dies away. In any case the result at the surface consists of the propagation of a wave through rocks of various degrees of elasticity. The cracking of the earth at the surface may have nothing whatever to do with the fracture below, and the vent, if any, may be at a great distance from the immediate source of disturbance.

Judging from their great frequency, from their constant recurrence in certain districts, and from the comparative periodicity of extreme paroxysms as well as of minor convulsions, there would seem little doubt that some widely spread general cause, cosmical and not merely terrestrial, is connected with and governs the forces brought into play on these occasions. From what we know of the electric force and its relations with earth magnetism, of the approximately superficial character of earth magnetism, and of the certainly small depth of most earthquake movements, as proved by the small area they affect, we can hardly avoid the conclusion that to the agency of heat initiated by electricity, and connected with these chemical results produced by the mutual action of natural substances under certain conditions of contact, we are indebted for the paroxysmal movements which record at the surface, however obscurely, what is going on far away out of our sight in nature's great laboratory.

Under the influence of the attraction of the moon and sun, the portions of the interior of the earth in a fluid state, no less than the waters of the ocean and the gases of the atmosphere, are doubtless subject to tidal influences, whilst the direct but periodic action of the rays proceeding from the sun changing, as it appears they do, during long but definite cycles, and according to laws which we seem now only beginning to recognise, may and most probably does bring about periodic paroxysmal action within the earth, which may thus seem to depend on months or seasons, on the moon's position, or the sun's clearness or obscurity, or on the magnetic state of the higher parts of the atmosphere, causes which one would think quite unlikely to have influence on what goes on so far out of the immediate range of their action.

It is true that nothing has yet proved a direct connection between earthquakes and such cosmical phenomena: but what is now known, the facts I have endeavoured to put before you to-day, support the conclusion that changes in terrestrial temperature, and in the circulation of electric, thermic, or magnetic currents, converting heat into force may produce, or in some way govern, the chemical changes which result in an earthquake.

No doubt both sun and moon do, both directly or indirectly, by light, by heat, and by electricity, as well as by the force of gravitation, largely influence all that is above, upon, or beneath the surface of our planet.

Perhaps also it will be found some day that the nature and even the extent of this influence are within the range of human discovery. These are, however, yet among the dark and unexplained mysteries of nature. We may suggest mutual relations, but we cannot follow out these suggestions into practical and definite conclusions.

And, lastly, what is our own position with reference to the chances of earthquake disturbance. We live in an area certainly subject to such movements, and not very far from those countries where the most severe earthquakes on record have happened. Any part of this area of western Europe and its shores is as liable to a great occasional upheaval as it is certainly affected constantly by small ones. We enjoy no immunity. Earthquakes have frightened our forefathers and may overwhelm us. The fatal explosion may happen this or next year; it may not happen in this century. It may originate beneath our very feet, or at the bottom of the ocean near our shores, or it may take place so far away that we hear only the faint distant echoes of the convulsive throe, but we are not the less certainly living over a mine ready to be sprung, and no one can tell when or where the fatal match will be applied.

NOTICES OF BOOKS, PATENTS, &c.

Plates representing the comparative Lengths of Staple of Cotton.—1. Cotton grown in India. 2. Cotton grown in the United States and other Parts of the World. Department of Reporter on the Products of India, India Office, July 1860.

These carefully executed plates, from drawings made by Mr. Wentworth L. Scott, under the direction of Dr. Forbes Watson, exhibit at a glance the comparative length of staple of the different kinds of cotton grown in various parts of the world.

Everybody interested in the growth of cotton—and who in Great Britain is not?—must be rejoiced to see the success which has attended the efforts to introduce the culture of cotton into many of the British dependencies. The native or indigenous cottons of India are all short stapled, shorter than the "Uplands" of the United States. But the introduction of the seed of the Sea Island cotton, as that grown on the low sandy shores of Georgia and Carolina is called, has already resulted in the production of an article which almost rivals its American progenitor in length of staple. That grown in Australia nearly equals the American in length.

It would be well if the Reporter were to issue, as a companion to these plates, an account of the different soils and other conditions of culture in the various localities. Such a work would be far more useful than many of the purposeless and utterly valueless reports that issue from our government departments.

CORRESPONDENCE.

The Comparative Properties of Milks and "Milk Essences."

To the Editor of the Chemical News.

Sir,—Whilst thanking you for the liberal amount of space given in your columns last week to a notice of the paper as above-named, I beg to offer some objection to the view taken on one or two points. In doing so, I hope it may not be supposed that I share the weakness attributed to authors ge-

nerally—that of being dissatisfied with anything short of unqualified praise; such is not my feeling, on the contrary I like a little adverse criticism; it is wholesome, and useful in more ways than one; it is a means of eliciting opinions on both sides of a question, and it affords—as in the present instance—an opportunity for explaining away misapprehension, and elucidating more fully the views and objects of the author.

With these apologetic remarks, I will, by your permission, follow the arguments of your reviewer in the order in which they occur. In the first place, he finds fault with the writer because she has not submitted to the "tedium and *desagrémens*" of the laboratory before attempting to propound her ideas to the public; and he also confesses to "complete disappointment" because the authoress does not prove to be a *chemist* in the most comprehensive meaning of the term.

Allow me to say that if such a lady could be found, I question whether she would not be met by a hint, tinged with sarcasm, to the effect that she had overstepped the limits assigned by custom, if not by nature, as the proper province or fitting field for the exercise of the feminine faculties. But however that may be I wish to explain that I have not aspired to any such distinction, and as my paper makes no pretension to the character (neither does it assume the form) of a "scientific essay," it is scarcely fair to judge and condemn it by that standard; it is simply *suggestive* as regards the chemical question, and the reviewer admits that the statements possess some interest for the consideration of the chemist.

Then again, I think the charge of "inconsistency" is scarcely substantiated, the ground of complaint under this head being merely that chemistry is spoken of in the paper as an "incomplete science" (an opinion which is afterwards subscribed to by the reviewer), and it is therefore objected that the practical conclusions are derived from those analytical processes whose results are capable of proof.

Now in the quotation given from the paper in the notice alluded to, it is stated that "*the results of chemical experiment are reliable as far as they go, but analytical processes cannot throw sufficient light on the subject in hand, for it contains subtleties which lie beyond.*" This, then, is the offending passage, which has evidently been misconstrued.

But to conclude. Your reviewer admits the following:—

First. That chemistry on the question of "essences" is an imperfect teacher.

Second. That there is probability of the existence of "essences" in milk.

Third. That analytical processes, as far as they go, are reliable and have guided the writer to a correct conclusion.

Fourth. That the system of feeding proposed is a very good one.

Thus every proposition being admitted in detail, or in the abstract, I have, after all, very little left to complain of, excepting that the critic has drawn a wrong conclusion from them, and in his anxiety to do justice to the science which he has undertaken to defend, he has rather overstepped the occasion, and has been doing battle with an imaginary foe. I have thus endeavoured to release my arguments from the disadvantages of obscurity and misapprehension, and I have done so in the interests of "infantine humanity," in whose cause you appear to sympathise so warmly as to lead me to hope that you will cheerfully afford the amount of space my letter demands on behalf of those poor little victims of ignorance and mismanagement, whom I am endeavouring to the best of my feeble efforts to befriend.—I am, &c.

THE WRITER OF THE PAPER REFERRED TO.

London, August 27.

[Ladies, we know, like to have the last word; but at the risk of provoking a rejoinder we must explain that our correspondent claims an admission which we never made. We did not confess chemistry an imperfect teacher on the question of essences—a question which lies altogether beyond the domain of physics, and belongs to metaphysics.]

Adulteration of Nitrate of Silver.

To the Editor of the CHEMICAL NEWS.

SIR,—In the CHEMICAL NEWS for August 4th, while reviewing the chemical part of *The Retrospect of Medicine*, you quote from it a very simple test for the adulteration of nitrate of silver, upon which I beg to offer a few remarks.

Glancing over the probable and possible materials with which nitrate of silver might be adulterated, it appeared so evident that many of the nitrates would not be detected by the test quoted, that I should not have thought the subject worthy of an experiment had not its publication in your journal given it an authority which would gain it a ready credence.

The nitrates of alumina, ammonia, lead, magnesia, manganese, mercury, tin and zinc, are those which seem most likely to be overlooked if the combustion test alone is had recourse to; of these the nitrates of ammonia and lead were selected for experiment.

Equal weights of nitrate of silver and nitrate of lead fused together, gave on cooling a mass somewhat darker than the pure silver salt (though probably that might be accidental), more crystalline and tougher, not quite so freely soluble in water, and leaving a small white residue; when powdered, rubbed upon paper, and burned it gave a tasteless residue of metallic globules.

Equal weights of the nitrates of silver and ammonia fused very readily, and on cooling gave a mass of a porcelain-like whiteness, and free from crystalline structure, deliquescent, rapidly and perfectly soluble in water; when burned upon paper, as before, it gave a tasteless residue of metallic globules, but the paper did not readily burn completely to an ash.

Farther experiment seems quite unnecessary, except it were in search of a test equally simple and sufficiently reliable. The Pharmacopœia test involving two careful weighings, if had recourse to at all, might, not improbably, prove unsuccessful in the hands of a medical man or person not skilled in chemical operations.

To meet their requirements the method most likely to be successful is one based upon the entire insolubility of the chloride of silver in hydrochloric acid, and its entire solubility in ammonia thus:—Take a fragment of the salt the size of a split pea, dissolve it in two or three drams of distilled water, contained in a phial, and add pure hydrochloric acid till it ceases to give a further precipitate, shake the phial briskly, and let the precipitate settle, which it will do most certainly if warmed, pour a few drops of the clear fluid upon a clean slip of glass, and evaporate with a gentle heat. If it leaves a palpable residue, the sample is *certainly* impure; if it leaves no residue or a scarcely visible one, the sample is *probably* pure: now add a decided excess of ammonia to the precipitate in the phial, and if it is entirely dissolved by this addition, the purity of the sample is confirmed, but any residue not soluble in the ammonia is a farther indication of impurity.

Excuse my occupying space with that which must be familiar to so many of your readers. I do it simply for the benefit of those who might be misled by the test formerly quoted.—I am, &c.

BARNARD S. PROCTOR.

Grey Street, Newcastle-on-Tyne.

The Sale of Poisons.

To the Editor of the CHEMICAL NEWS.

SIR,—Your correspondent, who signs "BARNARD S. PROCTOR," insists very strongly upon the importance of "*confining the poison-trade to the hands of those who are fit to be trusted with the responsibility,*" but he offers no suggestion as to the means by which such a *desideratum* might be effected. Perhaps he will in a future number give your readers the benefit of his views on this most important point.—I am, &c.

PRO BONO PUBLICO.

Arsenic in the River.

To the Editor of the Chemical News.

Sir,—Many of your readers have no doubt been struck, on reading the Reports of Dr. Letheby and Drs. Hofmann and Frankland on the "Presence of Arsenic in Dale's Disinfecting Fluid," with the considerable discrepancy in the amount of arsenic stated to have been found by these analysts in the solution of perchloride of iron. Dr. Letheby's second Report which you published has done nothing to remove the somewhat uneasy feeling which must have crept over many of your readers on perusing these analytical results.

Your correspondent has just seen a Report of Messrs. Versmann and Rodgers "On the Presence and Effect of Arsenic in Dale's Patent Magnetic Muriate of Iron," addressed to Mr. Dale, to which he would call the attention of your readers, since it seems to go far to explain the discrepancies observed by the first-named chemists.—I am, &c.

Tyro.

[We have to thank our correspondent for drawing our attention to the above-named Report. It will be found in full in the present number, p. 149.]

Precautions against Poisoning.

To the Editor of the Chemical News.

Sir,—When any one denounces "strong hopes" which he presumes to be entertained by somebody else for the accomplishment of an important purpose, he should be able to adduce some reasonable ground for so doing. And when one chemist throws cold water on an attempt made by another to promote such an object as the prevention of accidental poisoning, it is only natural to conclude he has some more hopeful scheme to propose.

Whether our "suggestions" are based upon weak foundations or not, we have strong hopes that they will at least be found, on examination, to have fewer weak points and many stronger claims upon the attention of your readers than the "precautions" Mr. Proctor advocates. At all events our "suggestions" have taken a *tangible shape*, which you are pleased to pronounce "almost perfect," which the *Lancet* has over and over again commended and recommended to general adoption, as have also all the principal medical journals of London, as well as the daily general press from the *Times* downwards. We are likewise in a position to quote the written opinions of some of the highest authorities in the medical profession, who consider our scheme "most ingenious, and admirably adapted to its intended object," and so on. Your correspondent's precautions amount to this, that one ought to "read the label in every case." Of course the label should be read, otherwise, why is it placed on the bottle? We always thought this was thoroughly understood, and that no one suspected medicines were made up at random, or by blind persons.

In every case of poisoning by accident most unquestionably it should have been "made a matter of conscience to read the whole label," *but it was not!* The "feeling of responsibility" happened just at that moment to be absent, and *there was nothing to recal it!*

Why, Sir, the label is admitted on all hands to have totally failed as a preventive of mistakes and accidents; even the addition to it of the word poison is and has been overlooked constantly. When dispensers or apothecaries in olden times were as 1 to 1000, and the poisons used in medicines were in somewhere about the same proportion to the present day, even then the label did not prevent accidents; how can it be expected to do so now with so many more persons employed, and so many more potent poisons in daily use among us? But Mr. Proctor thinks the knowledge of the doses and properties of medicines will act as a safeguard. We might as well say that a knowledge how to walk will prevent a man from stumbling, or, in fact, that knowing what is right we should never do wrong.

After expressing his doubts pretty freely about the practicability of our "suggestions," your correspondent makes an ingenious calculation, and arrives ultimately at a doubtful fractional amount of accidents to be prevented by their adoption. Leaving the arithmetical part of the question in Mr. Proctor's hands, we proceed to notice his statement with regard to the poor and their medicines: he says, "the cruet does duty in turn for laudanum or tincture of rhubarb," and "the porter bottle of to-day becomes the medicine bottle to-morrow." Now we believe the habits of the poor are everywhere more or less the same, and, as a rule, we find that one dose of medicine only, such as castor oil, or "something for bowel complaint," is as much as they buy at a time; indeed it seems to us somewhat incompatible with "pauperism" to purchase medicines in quantity such as a cruet would imply, or to indulge in the luxury of bottled porter. Certainly any family in which either the one or the other can be afforded cannot be considered too poor to make a permanent investment of 4*d.* or 6*d.* for two safeguard bottles, one for laudanum, and the other for the cooling lotion.

But the persons here alluded to are not those who stand most in need of protection from this class of accidents; in fact, we seldom or never hear of such occurrences among the poor. It is those whose minds are ever occupied, and frequently overstrained in the pursuit of literary and other professional, as well as mercantile, avocations who are apt to take up a wrong bottle and swallow its contents in a moment of more than ordinary mental excitement, or concentration of the thoughts upon the one absorbing subject; these are the persons for whom we think it most necessary to introduce a system of safeguard. Because ours or any one else's scheme does not profess to be infallible, surely that is not a sufficient reason for discarding or discouraging it. It would be the extreme of folly to say, because accidents may not be wholly prevented, no attempt should be made to prevent any. We might with equal reason dispense with danger signals on our railways, because we cannot prevent *all* railway accidents. Mr. Proctor does think that "Savory and Moore's suggestions might be useful if universally acted upon;" and if the new bottles "were adopted by persons who seriously felt the responsibility of their position, and were anxious to make use of additional precautions in this spirit, they will be useful." In what other spirit has any one ever advocated or anticipated the use of these bottles?

To return to the labels. So far from tempting to neglect or diminish the importance of the labels, the very essence of our scheme is to do exactly the reverse. It is, in fact, to strike the attention of the dispenser at the point where he *has overlooked* the label, and to send him back to it that he may read and have his thoughts thus recalled to the danger of heedlessness with what is in his hand. How can an ordinary bottle convey a warning under such circumstances? The label once overlooked—and every week proves it is done—what is there in that case to intervene between the omission and its perhaps fatal result? Besides, our estimation of the value of labels may be judged from the fact that the new bottles on our shelves have a *second label*, stating the dose or strength of the respective poisons they contain. It is about three years since the subject of accidental poisoning attracted the serious attention of Parliament and the public, what has been done in the interim? Is the *label* the only means of safeguard we (*i. e.* chemists and druggists) shall have to rely upon *when the next bill* is brought forward? Is that all that we have to point to in answer to the taunts and jeers of the opponents of legitimate medicine?

Until some arrangements are suggested which promise a greater degree of efficiency than our own, we shall continue and advocate the use of those we have inaugurated. Whether the new bottles be universally adopted or not, the experience of eighteen months' trial is amply sufficient to prove their utility as well as the ease with which they can be brought into extensive application.

We believe that by persevering in their employment we are discharging a duty we owe to ourselves, to the medical

profession, to those who assist in carrying on our business, and also to that portion of the public who take our medicines.—We are, &c.

SAVORY & MOORE.

New Bond Street, Sept. 4th, 1860.

Suggestions for the Manufacture of Urban Guano.

To the Editor of the CHEMICAL NEWS.

SIR,—I beg to forward you the following practical suggestions for the profitable application of town refuse. First I would suggest that an association be formed, consisting of landed proprietors and members of both Houses of Parliament, for the purpose of establishing a model work.

That members of the association should cause the new manure to be extensively applied on their estates, with a view of determining fully and fairly its real value. That the railway companies should be engaged to act as carriers and agents, for warehousing and distributing the manure at various stations throughout the most important agricultural districts. In the outset, night soil should be collected, together with an extra quantity of urine; to these materials should be added a fair proportion of the sweepings of the streets, and of other refuse in a suitable form. These materials to be thrown together into a large tank, having an arrangement at bottom for distributing warm air uniformly over the entire area, which is afterwards to be forced upwards through the mass, by which means it would be thoroughly dried and granulated. No deodorising process would be found necessary, but offensive vapours may arise during the operation, which are to be neutralised or consumed in the following manner:—The premises in which the operation is conducted must be enclosed with side walls and a tight roofing, leaving an opening on one side as an entrance; on the side opposite to this, a large furnace and chimney are to be erected, the furnace to consist of a grate for a fire to be kept in an active state of combustion by means of a blast; over this fire an arch is to be turned open at one side to the premises, the other to the chimney. By this arrangement, a current of air will be maintained through the premises, carrying with it the offensive vapours which would be neutralised or consumed in passing through the active fire below and the heated arch above; the products will then ascend to an upper region of the air in a highly rarefied state. The same fire to be applied to the heating of the air for the desiccating process; this will require a steam engine, which will also work a fan to keep up the active combustion of the fire.

By means of legislative enactments, the exercise of public spirit, and the force of public opinion, a modification in the use of water-closets must be brought about, so that little, if any, water may be used, and the products collected in water-tight reservoirs. In many cases these would have to be merely light sheet-iron tanks, capable of being removed by two men or stout boys; in others, large tanks may be sunk in the ground on the principle of cesspools, with an arrangement for emptying them by means of machinery, so as to render the operation inoffensive; urine must also be preserved as much as possible.

When the manufacture of urban guano has been matured and perfected by means of the model work, and the value of the manure fairly established, joint stock companies might then be formed to carry on numerous works in all parts of the Metropolis as well as in provincial towns. These works will afford instruction to agriculturists and the rural population in what manner they may economise their refuse, preserve the purity of their spring water, prevent unwholesome exhalations, and improve the land; reducing the cost of food, at the same time that the profits of farming would be greatly enlarged. It is quite possible so far to increase the productiveness of the land in the United Kingdom as to support its present amount of population; by which means the periodical drain of coin, for the purchase of food from other countries, and the consequent temporary embarrassment to the manufacturing and commercial interests of the country, would, to a great extent, be avoided.—I am, &c.

C. J. S.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Action of Zinc on a Solution of Alum.—Löwe has observed[1] that when granulated zinc and a blade of platinum are placed in a solution of alum, water is decomposed, the clear solution becomes turbid, and a white slimy matter is deposited on the two metals, which soon puts an end to the action. When examined with the microscope the slime is found to be composed of microscopic crystals. These crystals are insoluble water, but soluble in dilute hydrochloric acid. They contain—

Al_2O_3	49·214
SO_3	23·769
HO	26·594

The precipitate obtained by boiling zinc with a solution of alum differs from the above; it contains oxide of zinc.

Fluoride of Mercury.—Finkener describes this compound[2] as being formed when an excess of recently precipitated protochloride of mercury is digested in a solution of fluoride of silver, prepared by treating hydrofluoric acid with carbonate of silver. Chloride of silver is slowly formed, and a solution is obtained which, on evaporation, yields cubic crystals of fluoride of mercury. It may be procured more easily by neutralising hydrofluoric acid with carbonate of the protoxide of mercury. As the latter salt is added the liquid becomes turbid, and deposits a yellow crystalline powder of fluoride of mercury, which must be washed with a little water, and dried between folds of blotting paper, and over sulphuric acid.

The formula of the fluoride is Hg_2Cl. It is a rather unstable compound decomposing in moist air, and forming protoxide of mercury and hydrofluoric acid. It blackens in the light. Potash separates protoxide of mercury; ammonia gives a black precipitate containing mercury, fluorine and ammonia; it is probably an amidide; it is soluble in dilute nitric acid, but after time deposits a white matter containing mercury.

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[1] *Journ. für Prakt. Chem.* Bd. lxxix. 3428.
[2] *Annal. der Phys. und Chem.* Bd. cx. s. 142.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

M. H.—No. 2 glass will answer pretty well, although a darker colour would be preferable. No. 1 is too light.

A Constant Reader.—Nine parts white tallow or suet, and one part of olive oil, saponified with caustic soda.

J. B. E.—The oxygen equivalent is frequently taken as 100, as it evidently is in this instance.

Alpha.—Try digesting and boiling in soda ley.

Dr. Wallace.—Received with thanks. Will appear next week.

C. J. S.—Received.

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THE CHEMICAL NEWS.

VOL. II. No. 41. — September 15, 1860.

THE NEW MERCURIAL ELECTRIC LIGHT.

IN another part of our present number will be seen a short notice, extracted from a contemporary, of a new electric light invented by Professor WAY, in which by a most ingenious arrangement, the ordinary difficulties which are met with in the usual electric lamps are entirely overcome. An ever flowing stream of metallic mercury serves as a bridge to carry the voltaic force from one pole to the other, whilst its ready volatility and the extreme mobility of its particles are such as to prevent it from offering any obstruction to that evolution of light and heat which is obtained when a powerful voltaic current bridges over a gap in the continuity of the circuit. As a means of obtaining a steady uniform luminous glow in place of that fitful interrupted glitter which has hitherto been the chief characteristic of the electric light Professor WAY'S arrangement is perfect. Supplied with an ever burning yet incombustible wick of metallic mercury hermetically sealed in glass, we see no reason why this glorious light should not now descend from its position of a scientific curiosity to the domain of every day life.

This mercurial lamp seems to be the last improvement which was needed in order to render the magneto-electric machine of Professor HOLMES[1] of practical everyday value. By the latter instrument a two horse power engine is all that is required to grind out a perpetual, and intensely energetic magneto-electric current; whilst Professor WAY'S new discovery gives us an equally simple and effective lamp. The magneto-electric machine enables us directly to convert motion into electricity; and this new lamp receives the electricity and converts it into light. Nothing can be simpler,—nothing can be more perfect.

Our object in thus calling attention to this light is to point out some theoretical objections to its employment for the ordinary domestic purposes of illumination. The light which mercury gives when a voltaic spark is taken from it is of a very peculiar character. Unlike the light between carbon poles (the ordinary electric light) which evolves rays of every degree of refrangibility, and is consequently capable of illuminating any object with the exact colour which it is best able to reflect, the voltaic light from mercury consists of only six definite and homogeneous colours, each occupying a particular space in the solar spectrum and having wide black intervals between them. The first colour is a faint brick red, the second is a strong yellowish orange, the next a strong emerald green followed by a fainter green of nearly the same colour; then comes a rich ultramarine blue, and lastly a violet. Several invisible rays in the chemical end of the spectrum are also present, but as none of these can be rendered sensible, except by special and complicated arrangements, and only one of them is capable of passing through glass at all, they need not further be referred to here. It will be seen from the above how different the mercurial light is from any of the ordinary sources of illumination. Ladies complain as it is of the havoc which gas- or candle-light plays with the delicate tints and hues which it has been a source of pleasure as well as profit for chemists to fix on silks and other textile fabrics. But what will they say when, instead of a light which is only different to daylight in containing a slight excess of one group of rays, we illuminate a ball-room with one which is no doubt a very brilliant light, but which so far differs from sunlight as to be totally deficient in 94 per cent. of its coloured rays. The bewilderment which this would occasion can be imagined. Only those colours would be visible which were capable of reflecting the identical ray of the spectrum contained in the mercury light, and everything else, of whatever colour it might be by daylight, would be totally black. Instead of having a thousand varied hues and tints to rest the eye upon, we should be limited to the six colours named above, and their combinations; and anyone who has considered for a moment how intimately any internal illumination depends for its success upon the facility of reflecting and showing up varieties of colours and tints, will at once see that a source of light, however brilliant and valuable, can scarcely meet with private approbation if it is signally deficient in this property.

Whilst raising these objections against the mercurial light for private or domestic purposes, we are bound to say that for the higher and vastly more important purposes of public illumination, whether for lighthouses, ship signals, or street lighting, it would be invaluable both for simplicity and economy. For all these and many other uses it could be at once applied, and if the difficulty of the too great homogeneity of its colour could be got rid of (and we think, from what we know of the subject, that a little thoughtful research would overcome that) there would be no possible reason why we should not have our own private electric light laid on in every room of our house, as we now have gas or water.

[1] *Vide* CHEMICAL NEWS, vol. i. p. 173.

EXCISE CHEMISTS.

It may not be known to all our readers that the Government has started a chemical school. The Commissioners of Inland Revenue used to send pupils to University College at an average annual expense of 800*l.* They thought this rather dear, and their chemist thought he could do the teaching cheaper; so they have fitted up an extensive laboratory at Somerset House, and there the chemists employed by the Excise receive their chemical education. Now the first thing that strikes us is that the original outlay of 800*l.* a year, and the cost o the enlarged laboratory, were perfectly unnecessary expenditures of the public money. There are plenty of chemists to be had who have paid for their own education, and in most cases we believe have acquired a much better knowledge of the science than the Excise nominees who pass a short time in the laboratory at Somerset House. Such gentlemen are to be found in all our public laboratories, where it cannot be said they are too highly paid — gentlemen who have passed many years in the study, and have achieved some distinction in the science. It was quite possible for the Commissioners of Inland Revenue to command the same knowledge and talent without spending one farthing of public money on education, but for some reason or other it did not suit their purpose to do so. We shall watch with some interest the development of this scheme, to the consideration of which we shall shortly return.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Notes on some of the Chemical Reactions of Narcotine and Meconic Acid, by T. G. Wormley, *M.D.*

In the present article it is proposed to give some of the chemical reactions by which two of the *proximate principles* of opium may be recognised. The method of applying the tests is the same as that given in previous articles in regard to various alkaloids.

Narcotine.

Pure crystallised narcotine was dissolved in water, just sufficiently acidulated with hydrochloric acid to effect solution, and the reagents were applied to a grain of this solution.

I. Potash.—1. $\frac{1}{100}$th, grain of narcotine in one grain of water, when acted upon by a small drop of potash solution, gives an immediate copious white amorphous precipitate, which is insoluble in excess of potash, and dissolves readily in a few drops of strong acetic acid.

2. $\frac{1}{1000}$th, gives an immediate white amorphous precipitate, which after some little time is changed into beautiful groups of branched crystals, which are very characteristic.

3. $\frac{1}{5000}$th, an immediate precipitate, which very soon is crystalline. If there be much excess of the reagent, the precipitate will not be produced.

4. $\frac{1}{10000}$th, an immediate cloudiness, which almost immediately becomes crystalline, and after a little time there is a rather abundant deposit of aciculated and branched crystals.

5. $\frac{1}{50000}$, a perceptible cloudiness, soon much the same as in 4.

6. $\frac{1}{100000}$th, only a faint cloudiness at first, but very soon there is a deposit of aciculated crystals, which when examined by a microscope are rather abundant. In applying the reagent to solutions as dilute as this and the one preceding, it is necessary to use the least possible quantity, otherwise there will be no deposit.

II. Ammonia.—1. $\frac{1}{100}$th, grain of narcotine gives with ammonia an immediate white curdy precipitate, not readily soluble in excess of reagent, but readily in a few drops of strong acetic acid. After a little time the precipitate becomes crystalline, the crystals having the same form as those produced by potash.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{5000}$th, an immediate cloudiness, which very soon becomes crystalline; to obtain the ppt. the least possible quantity of reagent must be used. By suspending, for a few moments, a drop of ammonia over the narcotic solution, the latter is covered by a white cloudiness, which very soon becomes crystalline.

4. $\frac{1}{10000}$th, by applying the vapour of ammonia, no cloudiness is produced, but soon there is a very good deposit of crystals.

5. $\frac{1}{50000}$th, by using a small quantity of the ammoniacal vapour, there is soon produced a pretty fair deposit.

The carbonates of potash and ammonia behave in the same manner as the alkalies. Several specimens of iodide of potassium gave also the same reactions, and the same reactions, and the same crystalline form.

III. Chromate of Potash.—1. $\frac{1}{10}$th, gives an immediate copious yellow amorphous precipitate, which is readily soluble in acetic acid.

2. $\frac{1}{1000}$th, a yellow precipitate, soon crystals, same as produced by potash.

3. $\frac{1}{5000}$th, much the same as 2. Much increased by stirring.

4. $\frac{1}{10000}$th, no immediate precipitate, but very soon a good crystalline deposit, especially by stirring.

5. $\frac{1}{50000}$th, in a few minutes a quite perceptible crystalline precipitate.

IV. Bichromate of Potash.—1. $\frac{1}{100}$th, gives an immediate copious yellow amorphous precipitate, which after some time becomes granular. The precipitate is soluble in excess of acetic acid.

2. $\frac{1}{500}$th, a light yellow precipitate, very soon granular.

3. $\frac{1}{1000}$th, no indication after some time.

V. Sulphocyanide of Potassium.—1. $\frac{1}{10}$th, gives a white amorphous precipitate, soluble in acetic acid; the precipitate does not become crystalline by standing.

2. $\frac{1}{1000}$th, very soon, especially by stirring, a deposit of groups of prismatic crystals.

3. $\frac{1}{5000}$th, much the same as 2.

4. $\frac{1}{10000}$th, after a little time by stirring, quite satisfactory.

VI. Ferrocyanide of Potassium.—1. $\frac{1}{100}$th, gives an immediate dirty white amorphous precipitate, which dissolves in an excess of reagent, but is reproduced upon the further addition of the reagent. The precipitate is readily soluble in acetic acid.

2. $\frac{1}{1000}$th, gives a permanent precipitate with an excess of reagent.

3. $\frac{1}{5000}$th, a pretty good precipitate.

4. $\frac{1}{10000}$th, upon agitation gives a good cloudiness.

5. $\frac{1}{50000}$th, no indication after several minutes. None of the above deposits become crystalline.

VII. Ferricyanide of Potassium.—1. $\frac{1}{100}$th, gives

a bright yellow amorphous precipitate, permanently soluble in excess of reagent.

2. $\frac{1}{500}$th, by using a small quantity of reagent, a quite perceptible precipitate, readily soluble in excess.

VIII. Carbazotic Acid.—1. $\frac{1}{100}$th, gives a bright yellow precipitate, which does not crystallise upon standing.

2. $\frac{1}{1000}$th, a greenish yellow precipitate, soluble in excess.

3. $\frac{1}{10000}$th, gives a quite obvious amorphous deposit.

4. $\frac{1}{20000}$th, a just perceptible cloudiness.

IX. Terchloride of Gold.—1. $\frac{1}{100}$th, gives an immediate yellow amorphous precipitate, which nearly all dissolves upon heating, leaving a few orange gum-like masses; upon cooling the precipitate is reproduced. There is little or no reduction of the reagent upon the application of heat; in this narcotine differs from morphia.

2. $\frac{1}{500}$th, gives a good yellow precipitate, which does not all dissolve in several drops of potash solution, nor does the solution darken as in morphia. The precipitate is soluble in several drops of acetic acid.

3. $\frac{1}{10000}$th, gives a good greenish-yellow precipitate.

4. $\frac{1}{20000}$th, very soon gives a quite perceptible precipitate.

5. $\frac{1}{40000}$th, only perceptible, not satisfactory.

X. Bichloride of Platinum.—1. $\frac{1}{100}$th, gives a yellow amorphous precipitate, which nearly all dissolves by heat, and is reprecipitated upon cooling.

2. $\frac{1}{1000}$th, a pretty fair precipitate.

3. $\frac{1}{2000}$th, no indication.

XI. Tannic Acid.—1. $\frac{1}{100}$th, gives only a slight dirty white precipitate.

XII. Acetate of Potash.—1. $\frac{1}{100}$th, grain of narcotine gives with acetate of potash an immediate copious white amorphous precipitate of acetate of narcotine, which readily dissolves in a drop of strong acetic acid, but is insoluble in excess of reagent. After a little time the precipitate becomes crystalline, giving beautiful groups of acicular crystals, which radiate from a common centre.

2. $\frac{1}{1000}$th, gives a distinct cloudiness, which very soon changes to a rather abundant deposit of branched crystals, and ultimately as in 1.

3. $\frac{1}{5000}$th, no immediate deposit, but very soon crystalline needles appear, and after a little time there is a very good precipitate.

4. $\frac{1}{10000}$th, in a few minutes crystals appear.

5. $\frac{1}{20000}$th, in less than ten minutes needles begin to form along the edge of the drop, and in a little time the deposit is very satisfactory.

The *acetates of baryta, zinc,* and *lead* give much the same reactions in a hydrochloric solution of narcotine as those given above for the potash salt. In the first, second, and third solutions no difference is observed; in the fourth the precipitate is more slow to appear, and perhaps not so abundant, especially when the lead salt is used the deposit does not appear for several minutes; in the fifth case the same difference was observed between the potash salt and those of baryta and zinc, and no crystals were observed in the lead solution after standing one hour.

The above reactions point out a new test for acetic acid; however, we might state that the acetate of narcotine, when produced from the baryta or potash salt, is somewhat soluble in a solution of chloride of narcotine.

(To be continued.)

Analytical Notes, by Dr. Hofmann.

1. Separation of Cadmium and Copper.—Having had occasion to perform some experiments on the relative merits of the several processes which have been suggested for the separation of cadmium from copper, I was led to observe a property of sulphide of cadmium, which I do not find noticed in analytical manuals. Sulphide of cadmium dissolves with the greatest facility in boiling dilute sulphuric acid, which has no effect upon the sulphide of copper. On precipitating, by sulphuretted hydrogen, a solution containing not more than 1 milligramme of cadmium mixed with 1000 milligrammes of copper, and boiling the black precipitate for a few seconds with dilute sulphuric acid (1 part of concentrated sulphuric acid and 5 parts of water), a colourless filtrate is obtained, in which an aqueous solution of sulphuretted hydrogen produces an unmistakable precipitate of yellow sulphide of cadmium. Another solution of the same composition was mixed with an excess of cyanide of potassium and treated with sulphuretted hydrogen gas. A distinct yellow coloration was observed: a deposit likewise took place, but so slowly that in delicacy the former experiment appears to have a considerable advantage, especially since a solution of *pure* copper in cyanide of potassium also gives rise to a yellow coloration when submitted to the action of sulphuretted hydrogen.

2. Separation of Arsenic and Antimony.—The separation of these two metals, which presents unusual difficulties, has been a task of predilection with chemists, and a great number of processes have been suggested, the majority of which, it cannot be denied, admit of improvement. Among the many methods, the one which is based upon the dissimilar deportment of arsenetted and antimonetted hydrogen with nitrate of silver, deserves to be favourably mentioned, the former, as is well known, yielding arsenious acid, which passes in solution;

$$H_3As + 6AgNO_3 + 2H_2O = 6HNO_3 + 6Ag + HAsO_2,$$

the latter giving rise to the formation of antimonide of silver;

$$H_3Sb + 3AgNO_3 = 3HNO_3 + Ag_3Sb$$

which is insoluble in water. This process presents no difficulty as far as the arsenic is concerned, which may be recognised in solution by ammonia, if there be an excess of silver, or by sulphuretted hydrogen, if the silver has been entirely precipitated. It is far less easy to find, according to this process, minute quantities of antimony in the presence of large quantities of arsenic, the silver compound of antimony being mixed with a bulky precipitate of metallic silver. By treating this precipitate, as might readily suggest itself, with hydrochloric acid, there dissolves, together with antimony, a small quantity of chloride of silver, which is sufficient to darken the precipitate produced in the solution by sulphuretted hydrogen to such a degree as altogether to mask the presence of antimony. This inconvenience may easily be obviated by boiling the mixture of silver and antimonide of silver, after the arsenious acid has been carefully washed out by boiling water, with *tartaric acid*, which dissolves the antimony alone. The solution thus obtained yields at once the characteristic orange-yellow precipitate with sulphuretted hydrogen.

In some experiments made with the view of testing the delicacy of this process, 1 part of antimony in presence of 199 parts of arsenic, and *vice versâ*, 1 part of arsenic, together with 199 parts of antimony, could be easily detected. Even with minute quantities the

process proved successful, inasmuch as 5 milligrammes of either metal in the presence of 100 times the amount of the other could be satisfactorily exhibited. In evolving the hydrogen-compounds of arsenic and antimony, care must be taken to add as little nitric acid as possible to the hydrochloric acid used in dissolving the sulphides of the metals, since the presence of even moderate quantities of this acid greatly interferes with the free disengagement of the gases.

If there be tin with the arsenic and antimony, this metal will be deposited upon the plates of zinc used in evolving the hydrogen, from which it may be mechanically detached, dissolved in hydrochloric acid, and tested by the usual process.—*Quarterly Journal of Chemical Society.*

Contributions to a History of the Compound Ammonias, by Dr. HOFMANN.[1]

MANY years ago the author showed that the bromide or iodide of a quaternary ammonium under the influence of heat was divided into the bromide or iodide of a radical of alcohol and a tertiary monamine. Having lately returned to the study of this class of substances, he has been led to examine the action of heat on the salts of primary, secondary, and tertiary ammoniums. The experiments have shown that these bodies undergo a decomposition exactly analogous to the above. The chloride of a tertiary ammonium submitted to distillation furnished the chloride of an alcohol radical, and a secondary monamine; the chloride of a secondary gave the chloride of an alcohol radical, and a primary monamine; and, lastly, the chloride of a primary ammonium decomposed into the chloride of the alcohol radical and ammonia.

The author's former experiments proved that it was possible to *ascend* in the scale of the ammoniacal derivatives by replacing one after another by radicals the four equivalents of hydrogen of the ammonium. It is clear, likewise, from the experiments now described, that we may also *descend* the scale by substituting successively, step by step, hydrogen for the radical. Let us take, for example, the salts of ammonium of the ethylic series, the only one which the author has yet examined.

Ascending Scale.

$$\underbrace{H_3N}_{\text{Ammonia.}} + \underbrace{C_2H_5Cl}_{\text{Chloride of Ethyl.}} = \underbrace{[(C_2H_5)H_3N]Cl}_{\text{Chloride of Ethylammonium.}}$$

$$\underbrace{(C_2H_5)H_2N}_{\text{Ethylamine.}} + C_2H_5Cl = \underbrace{[(C_2H_5)_2H_2N]Cl}_{\text{Chloride of Diethylammonium.}}$$

$$\underbrace{(C_2H_5)_2HN}_{\text{Diethylamine.}} + C_2H_5Cl = \underbrace{[(C_2H_5)_2HN]Cl}_{\text{Chloride of Triethylammonium.}}$$

$$\underbrace{(C_2H_5)_3N}_{\text{Triethylamine.}} + C_2H_5Cl = \underbrace{[(C_2H_5)_4N]Cl}_{\text{Chloride of Tetrethylammonium.}}$$

In the descending scale the decompositions are exactly reversed.

These reactions, although extemely interesting in a scientific point of view, unfortunately admit of but a limited application in practice. Many circumstances, which are difficult to avoid, interfere with the completeness of the transformations. If the temperature is not sufficiently high, some portion of the ammonium salt submitted to distillation sublimes unaltered; and further, part of the same salt is reproduced in the neck of the retort and receiver, by the recombination of the bodies it divided into; and lastly, if the temperature is raised too high, it happens that the chloride of the monoatomic alcohol is decomposed into a diatomic radical and hydrochloric acid, the latter forming with the monamine liberated by the reaction a salt which is in its turn also decomposed. Thus the chloride of diethylammonium gives, at the same time as the chloride of ethyl and ethylamine, some ethylene and chloride of ethylammonium, the latter again splitting up into chloride of ethyl and ammonia.

The author proposes to apply the reactions he has pointed out to the phosphorus series, and hopes in this way to obtain diethylic and monoethylic phosphines, bodies which have not yet been produced.

[1] *Comptes-Rendus*, t. li. p. 234.

TECHNICAL CHEMISTRY.

On the Causes of Fire in Turkey Red-Stoves, by WILLIAM WALLACE, *Ph.D. F.C.S. Glasgow.*

[Read at the late meeting of the British Association at Oxford.]

FIRES occur spontaneously in Turkey-red stoves with alarming frequency, and within the past few years the amount of property lost annually in this way has very much increased, owing to modifications introduced into the mode of operating. The fire insurance offices charged, about ten years ago, 3*l.* 3*s.* per cent. upon buildings of this class, but the rate has now been raised to 7*l.* 10*s.* per cent., while several offices refuse altogether to grant policies of insurance upon them. Notwithstanding the very high rate of insurance, it is believed that it is very far below the amount that would be required to cover the immense losses that occur from year to year.

To those who are unacquainted with the process of Turkey-red dyeing as practised at the present day in this country, it will be necessary to give a brief account of the mode of procedure so far as the stoves are concerned.

The cloth, after undergoing an imperfect bleaching process, is passed through a very weak solution of carbonate of potash or soda, and then soaked in olive oil. It is now allowed to lie in heaps for a couple of weeks, during which it is frequently turned over, to prevent accumulation of heat, arising from the low combustion of the oil. The next process is the stoving, which consists in hanging the cloth for a number of hours in a building heated to 160° or 180° F. This is by far the most dangerous part of the process, nine-tenths of the fire occurring in this, the first stoving. The cloth is afterwards passed through a solution of alkaline carbonate and again stoved, and these operations are repeated seven or eight times. The cloth is then ready for impregnation with the aluminous mordant. Two kinds of stoves are in use; the "pin stove," in which the cloth is stretched longitudinally upon little wooden pins projecting from a framework, and the "hanging stove," in which the cloth depends, in lengths of about twenty feet, from spars placed near the roof of the building. In both of these stoves the different layers of cloth are placed as close together as possible, but actual contact is avoided.

In endeavouring to ascertain the cause or causes of fire in these buildings, the first point to which I directed my attention was the effect produced by contact of air with the heated oil and the vapours given off from it. I found that when cold air was forced through oil heated to 400° or 450° the temperature rose several degrees,

and fell again as soon as the current of air was interrupted, thus proving that the oil undergoes a process of low combustion when brought in contact with air at a high temperature. In another experiment the vapour arising from the oil took fire spontaneously after blowing air into the vessel for some time, showing that the heat had gradually accumulated until the temperature was reached at which spontaneous inflammation of the vapour occurs. The temperature in this experiment was not ascertained, but it was probably about 600°. In many cases of fire it has been observed that the cloth acquired a brown colour before combustion commenced, and I have ascertained that this coloration is not produced at a temperature inferior to 300°. Again, it has been remarked that fires seldom, if ever, begin in the lower parts of the building, where the flue-heat is greatest, but generally in the top story, or near the roof, and often at the point where the air has access to the interior of the building, and becomes mixed with the evolved gases.

There are, therefore, two sources of heat in these stoves; that supplied by the flues, and that generated by the low combustion or oxidation of the oil. Hence it is obvious that unless means are provided for the escape of the combustible gases, and the ready diffusion of the air, the temperature will quickly rise to a dangerous degree in those parts where numerous folds of cloth are situated furthest from the passages or openings where diffusion may take place.

Having thus explained the circumstances which lead to the occurrence of fires in these buildings, I have now to point out the precautions which should be adopted to prevent a repetition of these disasters, which frequently involve loss of life as well as property.

The free diffusion of the air in the stove, so as to prevent accumulation of heat, is undoubtedly the great safeguard, and this can be effected only by leaving a sufficient space between the layers of cloth.

Another important precaution is the use of means to procure thorough ventilation. Some dyers have openings near the flues, and corresponding orifices in the roof kept constantly open during the stoving of the cloth, and such stoves have been wrought for many years at a temperature of 180° without the occurrence of any accident. On the other hand, numerous fires have taken place in stoves heated only to 160°, but without communication with the exterior atmosphere, except by one or two small openings in the roof. In such buildings fires have been occasionally observed to begin only after the stoving was finished and the windows opened, and we can scarcely doubt that these fires owed their origin to the rapid oxidation of the oil and its vapour, caused by the sudden access of an abundant quantity of air. My experiments have shown conclusively that oiled cloth may be heated even to 250° without the slightest danger of spontaneous combustion, provided that there is free diffusion of air and sufficient ventilation.

A third means of insuring safety is to saturate the cloth with a stronger alkaline liquor before soaking it in oil, as the oil is thereby rendered less readily oxidable. Owing to this very circumstance, however, the stoving process is less efficiently performed when a stronger alkaline liquor is employed.

It is well known to practical Turkey-red dyers that risk of fire may be diminished by lessening the quantity of cloth, and by using more alkali; but they object to the first as making the process more expensive. and to the second as affecting the brilliancy of colour in the finished goods. They are averse to the introduction of ventilation, because it involves a little loss of heat, but I am convinced that the extra cost would be trifling compared with the manifest advantages obtained, not to speak of the diminished insurance rate that will be demanded. If some improvement of this kind is not introduced insurance companies will, in a few years, refuse to issue policies on these buildings altogether, or at least on those that are not properly ventilated.

It may not be uninteresting to add a few remarks upon the object attained by the stoving process. It is well known that the colour called Turkey-red cannot be dyed without the use of oxidised oil, yet no chemist has announced to us what the actual mordant is which produces this most durable and brilliant colour. Persoz states that it is of an oily nature, that it is soluble in acetone, that it may be transferred from one piece of cloth to another, and, finally, that the colour can be dyed with it alone, without the intervention of an aluminous mordant. My experiments confirm these with the exception of the last, and I have found a cheap solvent for the oily mordant. Whatever the composition of this oily substance may be, it is unquestionably formed by the oxidation of one or more constituents of oil. The oxidation may be effected in a variety of ways: by exposure to air and light, as in the old process, still continued in some districts, especially for yarns; by soaking the goods with repeated doses of a soapy emulsion of olive oil and alkaline carbonate, and stoving after each immersion; or by the method already described in the former part of this paper. In some processes in use in Switzerland and France nitric acid has been employed as a substitute for oxidation by the atmosphere; and the use of this acid has been tried also in this country, but with limited success. I have lately made some experiments from which I have concluded that the oil may be oxidised, not on the cloth as at present, but before impregnating the fabric with it, thus doing away with the stoving process altogether. I doubt much, however, whether this method could be carried out successfully on the large scale. I am at present engaged in the extraction from cloth, finished so far as the oil process is concerned, of a quantity of this oily mordant sufficient for analysis and an investigation of its properties. Perhaps it is not too much to hope that when its true composition is known, an economical method of preparing it may be found; and that it may, at some future time, he applied to fabrics with as much ease, rapidity, and certainty, as other mordants in common use.

Excise Chemistry.—Report on the Laboratory, by Mr. G. Phillips.

(From the Report of the Commissioners of Inland Revenue.)

The Laboratory has now been eighteen years in operation, and it has long been its duty to investigate, when required, any subject affecting the revenue which involved the application of chemistry or the microscope. Within the last seventeen months it has received a large accession of business, which has necessitated several important alterations in its management and arrangements.

When in 1858 the Board resolved to give a certain number of officers a chemical education in their own laboratory, instead of sending them, as formerly, to University College, London, I felt a deep sense of the responsibility which thus devolved upon me; and this feeling was not lessened by the fact that the apartments in which the business of my department was then temporarily carried on were totally unfit for educational pur-

poses. In October 1858 nine officers commenced a systematic course of chemical instruction under my superintendence, and until June 1859, when the Laboratory was removed to its present commodious rooms in Somerset House, their progress was to a considerable extent retarded by the want of accommodation adverted to. Considering this disadvantage, and likewise a far greater, but also remediable one, arising from a want of experience in imparting instruction, I am naturally much gratified at the result of the severe and impartial examination to which the students were subjected in December last. This satisfactory result is highly commendatory to the students, and renders it unnecessary for me to add one word in their praise.

The number of samples analysed in the practical branch of my department during the year just ended amounts to 9631, being 2865 more than the number examined in 1858. These figures, large as they are, give but a very imperfect idea of the amount of work performed, which, during the period to which the report relates, has involved not less than 5000 distillations, and nearly 16,000 weighings; whilst the number of papers which have, within the same period, passed through the department, and been reported upon, is upwards of 7000. As the work of the Laboratory increased, it became necessary to increase the accommodation, and to systematise and simplify as far as possible the regulations under which the business of the department was conducted. The former of these objects has been sufficiently attained by the removal of the Laboratory to its present rooms, which have been most efficiently arranged and fitted up with special regard to the purposes to which they are now applied. Until recently, the particulars relating to each sample, the results of the analyses, and the registration for easy reference of the whole work of the department were entered in books of plain paper, thus causing, besides a loss of neatness and uniformity, a very large amount of avoidable labour in ruling and titling. This defect is now remedied, the various books are well kept, and the assistants have more time to devote to other duties.

Since the date of my last report 24 examiners have been instructed in the Laboratory, making a total of 85 who have thus had the opportunity of becoming acquainted with scientific modes of detecting adulteration. Of this number about 60 are now supervisors, and as many of them, by the purchase of expensive microscopes, have evinced a real interest in the study of the various features of adulteration, it may not be unfairly assumed that beneficial results will be derived from the system of teaching in question. That benefit has already accrued to the revenue may be shown by mentioning one case in which, during the past year, a supervisor in the provinces, who possessed a microscope, applied it to some of the articles sold by the traders under his survey; the result being that a wholesale fraud both upon the revenue and the consumers of a certain article was discovered in London, and the persons implicated punished.

In my report for the year 1858, I referred to the experiments which were being made in the Laboratory for the purpose of eliciting data upon which instruments and tables might be constructed for ascertaining the strength of spirits possessing an alcoholic value beyond that of the strongest spirits to which Sikes's hydrometer and tables are applicable. The completion of these experiments has been unavoidably delayed owing to the mildness of the last two winters, and it has been only since the commencement of the present year that the weather has been cold enough for a sufficient period to enable me to obtain the whole of the experimental data required. The investigation has been one of extreme difficulty, but I believe its results will be found trustworthy and valuable, as they have placed in our possession means, hitherto wanting, by which the strongest spirit even to absolute alcohol can be assayed at any temperature between 40° and 85° F. The formation of tables from the data obtained yet remains to be done, and as this will involve much careful calculation of a somewhat intricate nature, a considerable period must necessarily elapse before the object in view is fully attained.

Tobacco.—The practice of examining the tobacco manufactories of the country has been continued during the year, a great number of them having been unexpectedly visited by myself, and a few by some of my assistants. In addition to this, experienced officers, who have been educated in the Laboratory, and who are stationed in those towns where the manufacture of the article is carried on to a large extent, such as Liverpool and Bristol, are enjoined strictly to examine at uncertain times the operations and stocks of the manufacturers. From my own extensive observation, and the concurrent testimony of these officers, I have no hesitation in saying that the adulteration of tobacco is now but seldom attempted. That an article, which, from the high duty upon it, the keen competition existing among its manufacturers, and its almost universal consumption, offers stronger incentives to its sophistication than perhaps any other commodity, should generally be sold in a pure state fairly shows that its freedom from adulteration is due partially, if not mainly, to that strict supervision of its manufacture which has for years been exercised by the revenue.

Of the large number of samples of tobacco examined on the premises of the manufacturers within the past year, it has been necessary to select only 57 for analysis; and of these 16 only were adulterated. One sample was of the description known as "roll," and consisted chiefly of cabbage leaves, the outside covering only of the roll being tobacco.

The following ingredients were found in the adulterated samples:—sugar, liquorice, oil, and carbonaceous matter, cabbage leaves, nitrate of potash, sulphate of magnesia, common salt, ammonia-alum, and carbonate of lime.

Snuff.—Up to 1856 the practice of adulterating snuff was very prevalent, particularly in Ireland, no less than 52 per cent. of the samples examined in that year being illicit. In 1858 the corresponding percentage was 7, and in the year now ended 9.

The partial abandonment thus indicated of the fraudulent practice is the more satisfactory when it is considered that snuff, unlike tobacco, can be easily sophisticated by the person who retails it, and that too to a large extent without exciting the suspicion of the purchaser, the appearance and pungency of the article being so little changed or impaired by the introduction of illicit ingredients that, in most cases, the fraud can be detected only by experienced persons with the aid of the microscope.

In the manufacture of snuff known as "Irish" and "Welsh," the law permits the use of *lime water*; and some manufacturers have been in the habit of abusing this permission by using, not lime water alone, which is sufficient for the proper preparation of the snuff, but a thick mixture of that fluid and powdered lime, to an extent constituting an adulteration in its worst form, being physically injurious to the consumer as well as a serious fraud on the revenue. It is not easy to suppress this

practice from the fact that a certain but undefined amount of lime is necessary in the manufacture of the snuffs in question; it being consequently difficult to obtain a conviction upon an analysis of the finished article. Within the past year, however, two manufacturers have been detected in the act of adding large quantities of a thick mixture of lime and water to the tobacco stalks in process of being made into snuff, and have paid penalties in consequence, besides forfeiting the adulterated materials.

Whilst in 1856 it was found necessary to analyse in the Laboratory 209 samples, of which 110 were adulterated, in the past year it has been deemed requisite to select only 11 samples for that purpose, and of these 10 proved to be genuine.

The adulterated sample was from Ireland, and contained roasted oatmeal.

Pepper.—The experience of the past year has fully borne out the opinion I expressed in my last report, that pepper was not so much sophisticated by retailers as by grinders of and wholesale dealers in the article. In 1859 the discovery of some adulterated pepper in the possession of a retailer in the country led to the seizure of a large quantity of similarly adulterated pepper from the warehouse of a firm of wholesale dealers in London, and immediately afterwards a further seizure was made on the premises of another firm that had ground the commodity. Both these firms were prosecuted to conviction, and paid heavy penalties. The illicit material used in this case was sago flour, and it was stated, in extenuation of the offence, that the pepper seized was of fine quality, and that by mixing it with a certain percentage of some cheap and innocuous substance, such as sago flour, the public was served with a better article than could be obtained for the same money when genuine pepper was purchased. Besides the above, several detections have been recently made, the prosecutions relating to which are depending.

It is more than probable that the wholesale dealers who adulterate their pepper resort to the practice, not with a view to obtain a large percentage profit, but that they may be enabled to extend their business by underselling those of their competitors who deal only in the genuine article.

From the results obtained in the Laboratory during the year just ended, it appears that the practice of adulterating pepper is not only very general, but that it is increasing; for whilst in 1856, out of 95 samples analysed only 27 were found to be adulterated, in the past year of 99 samples examined as many as 78 were illicit.

The adulterating ingredients found in the samples examined within the last year are the husks of red mustard, white mustard, and rape seeds, sago, and cereal starches, and powdered slate. Besides these, many of the samples contained capsicum, long pepper, and a very large and undue proportion of the stalks and husks of pepper.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Case of Poisoning by Vermin Powder.

Ann Collins, aged 20, a domestic servant at Cheltenham, committed suicide by taking a packet of "Board's Vermin Powder." It appeared from the evidence, that symptoms of poisoning by strychnia must have come on very soon after the deceased had swallowed the poison, and death ensued in about an hour and a quarter. The following is the chemical evidence given at the inquest.

John Horsley, Esq. analytical chemist—I analysed a portion of the contents of the glass and of the powder in the presence of Mr. Jessop. (The paper containing the powder produced with Mr. Jessop's initials upon it.) The word "poison" cannot be seen from the outside. It is on the inner paper, and to see it you have to tear off the outside. I first examined microscopically a portion of powder, scraped from the glass. I observed granules of starch, with amorphous masses of black powder analogous to that of charcoal, as well as broken and ill-defined crystals. My next object was to ascertain—as I expected to find strychnia—if the powder was bitter. By applying a little to my tongue, I found it was intensely bitter. That is one of the particular tests in the detection of strychnia. Next I scraped a portion off the glass, and put it on a white plate like this, moistened with concentrated sulphuric acid, and touched it with this crystal, which is called bichromate of potash. Strychnia, in its pure state, is white. It is obtained from this nut (*nux vomica*). I produce the nut, and the powdered nut, as well as the pure strychnia obtained from it, which is of a white crystallised character. The effect of the chemicals is to liberate a stream of oxygen, which communicates a deep violet colour, passing through several changes, till it ultimately becomes yellow. So far that was an examination of this. I was present at the autopsy on Saturday with Mr. Jessop. I thought for my purpose the stomach and the heart would be all that was required. I opened the stomach in the presence of two medical gentlemen, as soon as I got home, at 5 o'clock. There did not appear to be anything particularly wrong about it. I have had a good deal to do with strychnia in its effects on animals, but not human beings. There was nothing wrong in the coating of the stomach. It contained from four to five ounces of semi-fluid pultaceous matter, consisting principally of portions of French beans and potatoes, portions of an apple or pear, with its pips, shreds of bacon with lean and fat. I divided the contents into two portions, and proceeded by two or three ways, particularly the processes of Rogers and Letheby; that is to say, I digested the portion of contents for twelve hours in distilled water, mixed with pure acetic acid. The object of the acetic acid was to render the strychnia soluble.

Mr. Willey, foreman of the jury, asked the Coroner if it were really necessary to go into all this. What they had to decide was whether the deceased died by poison.

The Coroner said the information might be useful, but if the jury did not wish to hear the details of the medical evidence, he would ask Mr. Horsley to state shortly whether he found any strychnine.

Mr. Horsley replied that he succeeded in detecting pure strychnia, but the quantity was inappreciable.

The father of the deceased (to Mr. Horsley)—Were you the person who sold the poison? (Laughter.)

Mr. Board—How much did you obtain?

Mr. Horsley—It is impossible to estimate.

Mr. Board—How much did you detect in the whole? It is beyond estimation; a small quantity; suffice it to say it comports itself like ordinary strychnine.

Coroner—Did you find any other poison?—I searched for arsenic, but could not find it.

Mr. Board—Did I understand you to say you found 1¼ grains?

Coroner (to Mr. Horsley)—No sir, you said the portion was so small as to be almost inappreciable.

Mr. Horsley—That is what I said.

Coroner—Do you wish to say any more?

Mr. Horsley—Here is the strychnia obtained from an

original packet of Mr. Board's powder. [This was shown on a small glass vessel, hollow in the centre, to which the strychnine adhered.]

Mr. Willey—Was the quantity sufficient to kill a person?

Mr. Horsley—Certainly, but it was only a small portion I detected in the contents of the stomach.

Walter Jessop, Esq. surgeon, deposed—I made a post-mortem examination on Saturday. The body presented the appearance of an exceedingly healthy young woman, and few of the appearances generally supposed to attach to a death from strychnine. There was certainly rigidity of the muscles, and the spine was slightly arched, which is one of the results of that poison. The whole of the contents of the body were of a healthy character. The heart was a healthy organ containing little fluid. I removed the stomach and contents in the presence of Mr. Horsley. It contained but little fluid, and I handed it over to him for the purposes of examination. The contents of the stomach were quite sufficient to cause death.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture V. *On Volcanos.*

In my last Lecture I explained the nature of those almost incessant paroxysmal movements that take place beneath a very large part of the earth's superficial crust, sometimes causing great destruction to life and property, and producing results at very great distances from the original source of disturbance. I then showed you that owing to some chemical action within the earth there seems to be a constant struggle to open a communication with the surface, and that when this communication was made, earthquakes for a time ceased or became less terrible.

The relief caused by the fracture of the earth's crust is accompanied by certain other phenomena, which are generally spoken of as *volcanic*. It is my object to day to place before you some of the facts that have been determined, and the causes that have been assumed to operate in producing these phenomena.

The first point is to explain what is meant by a *volcano*, and the difference between *active* and extinct volcanos, and how far these phenomena are continuous or broken by intervals, whether they extend over all parts of the earth, or whether they are confined to certain distinct places, and do not occur in other places where from our experience they never have occurred, and so we presume they will.

Generally I may say then that among volcanos, or in all those places upon the earth where there is any exhibition of what we call volcanic phenomena—these consist of eruptions of gases, steam, water, mud, volcanic ash or dust, stones and lava. Volcanos are sometimes low hillocks, such as the air volcanos in some countries, where there is an eruption of mud, very frequently with sulphur, and sometimes with hot water. Occasionally there is an eruption of sulphur and sulphurous acid, as in *solfataras*. These are volcanic phenomena of the simplest kind, and take place close to the surface, and at various levels, generally very small. At higher levels, and forming hills sometimes 2000 or 3000 feet high, there is a remarkable instance in Stromboli in the Mediterranean, which is 2300 feet. Still loftier hills are Vesuvius, nearly 4000 feet. Others again are lofty mountains. Thus Etna is nearly 11,000 feet, and the peak of Teneriffe, consisting of a remarkable volcanic cone, is about 12,000 feet.

In other parts of the world, as in South America, there are volcanic cones 20,000 feet high, such as the Cotopaxi. It is clear therefore that volcanos may rise from the level of the sea to any height. They may also occasionally be very low, far below the level of the sea; for eruptions have taken place at sea with all the usual phenomena. They are very widely distributed over the earth; in definite bands or zones, which are so far distant that we can either group them together, or group them so that there shall only be one or two isolated exceptions. There are some in most parts of the world,—in Europe, in the Atlantic Ocean, in Asia, in the Asiatic islands, in Africa, and in the islands of the Pacific, and in America both North and South.

I next proceed to particularise:—First of all there is a group of volcanos in Europe. There are about seven distinct volcanos in Europe, of which four are active. Etna, Vesuvius, Hecla and Stromboli are all well known.

There is a group in Central Asia and one in the Bay of Bengal. In Asia, on the continent there are about twenty-five distinct volcanos, of which fifteen are known to have been active in recent times. When I say active I mean in that their eruptions have taken place at intervals within human knowledge. If those intervals are recorded, then the volcanic region is said to have been active. If there is no record then we must call it an extinct volcano, unless there is other evidence than human testimony of their having been in action within a comparatively recent period. A great many have not been active within the last geological period. Of active volcanos I have alluded to those on the main land of Europe and Asia, now I shall direct your attention to those in the islands of Asia. These are among the most remarkable known. An extraordinary group runs from the southern side of India, on the east side of the Bay of Bengal, in a curved line among the Asiatic islands, on which curved line there are no less than 198 volcanos, of which 115 are known to be active. Proceeding from these into the Pacific you will find as many as 40 volcanos known, of which rather more than half are known to be active. On the other side of the Pacific, on the American side, we come to a remarkable volcanic group, connecting with Asia by the island of Japan and Kamstchatka. There are 24 volcanos in the north-western part of North America, of which 5 are known to be active. In Central America there are 35, of which 22 are active, and in South America there are 56, of which 26 are active. I mention the numbers because it is only by figures in this way that one can get anything like a notion of relative importance. I should also add that in South America altogether there are a great many more than 56 volcanos. Thus if you take each separate cone, the number is more than doubled. There is in fact that number of distinct groups. Some of these groups are several hundred miles apart. They form five belts, each having a large group of volcanos. The principal development of volcanos then is in bands or zones, and there are seen in Europe, Asia, so far as it is known, the Asiatic islands, Western America, and the West Indies. In all these countries where there are so many active there are few extinct volcanos. Volcanos are sometimes connected together so far that when an eruption takes place in one it does not take place in the one adjoining, one seems to relieve the other. But in very many cases there is no apparent connexion of this kind. It is quite certain that whatever connection there may be, by which at very considerable depth below the surface earthquakes are connected with volcanos, is in this sense, that where they are both common, and their action is to a certain extent regular, earthquakes alternate with volcanic eruptions — an earthquake generally preceding a volcanic eruption, but not generally succeeding. I have already mentioned eruptions beneath the sea. Those are occasionally very striking phenomena, and let us know what eruptions may be. An eruption took place at sea off the island of Juan Fernandez, but was not accompanied with any eruption known on land. Another took place in 1831, that of Graham Island in the Mediterranean, on which occasion the island rose bodily out of the sea. Before the eruption there had been the considerable

depth of about 200 feet of water. In a very short period after the eruption began it first made a shoal in this water and this shoal gradually rose to the surface and formed an island above the surface. After a time the island rose irregularly, more on one side than the other. At the time when it was completed the highest part was more than 100 feet above the water, and as there were 200 feet below the water, there was a mass lifted amounting to about 300 feet in height and three miles in circumference. This island is a good illustration of the mass of matter thrown up, and shows clearly what a volcanic eruption is. A volcano terminates upwards with what is called a crater, which is either a deep hollow like a coffee cup, or a shallow hollow like a basin, or more shallow and larger in proportion, like a saucer. They vary much in size, from a small reef up to 15 or 16 miles in circumference, — the largest known is about 16 miles. It is a shallow or saucer-shaped crater in the island of Owhyhee, in the Pacific. There is reason to suppose that in our satellite the moon there are craters of very much larger size. The lunar craters differ from those of the earth in being comparatively larger and connected with each other, while on the surface of the earth they are smaller and detached. The surface of the moon therefore is much more volcanic than the surface of the earth.

The sides of volcanos which, generally speaking, are more or less conical in shape, are made up partly of ashes or dust, and partly of what is called lava, which was at one time rock in a melted state, and has cooled under exposure to the atmosphere. The ashes are nearly the same in composition, only the mineral is in an exceedingly fine state of division, produced probably by gas mixing with the melted rock, and forming innumerable bubbles. These being broken into fine dust are easily blown about. The scoriæ or rapidly cooled ashes are also common. The cones are built up with sloping walls.

These then are the principal phenomena connected with active volcanos. There are also volcanos which are extinct. Such extinct volcanos are well known in central and southern France, there is a group on the banks of the Rhine, another in North Italy, another in Eifel, another in the Black Forest in Germany, another in Styria, another in Hungary, another in Spain, another in Asia Minor, and another in India. These are all regions of extinct volcanic action; we can see them distinct volcanic cones, abundance of ashes, and beds of lava, all these results being peculiar to volcanos, and not to be mistaken for anything else. On the other hand we find these countries covered with marks of subsequent operations that do not admit of the supposition that they have been subjected to volcanic action since the introduction of man upon the earth. The probability is that some of those have become recently extinct, and that some have been extinct for a very long period.

Those are the points with regard to the principal volcanos. Now I must show you what results we obtain from them. This is a subject which admits of very great detail, and I can only give it in a very general way. In the first place almost all volcanic eruptions commence with noise. The noises that are heard previous to the commencement of an eruption are sometimes exceedingly loud — so loud as to be heard over vast tracts of country. In one case, in 1835, there was a noise preceding a volcanic eruption which was heard as far from Coseguina to Jamaica on one side, and Bogota on the other, which would be somewhere about the distance between London and Algiers. If, for example, such an eruption was about to take place in Algiers the noise might be heard all across the continent of Europe as far as our own island. This is not by any means a solitary case. There was a case in the year 1812 in which a volcanic eruption occurred in the Island of St. Vincent, and the noise was heard over an area of 3,000,000 of square miles. The noises sometimes are continuous, and generally interrupted and varying in their nature. After the noise there is generally-speaking an eruption of aqueous vapour or steam mixed with gases containing considerable quantities of sulphur, sometimes sulphuretted hydrogen, but more generally sulphurous acid. Very large quantities of sulphurous gas are thrown into the air, and at the same time very large quantities of the vapour of water, so that the walls of the great craters are generally well supplied with sulphur. It is in this way that the sulphur of commerce is obtained — Vesuvius and Etna supply enormous quantities.

After the noise slight shocks succeed each other very rapidly; as many as 267 distinct shocks were counted in an hour on one occasion. Then comes in most cases a very large outburst of fine dust, generally speaking dry, but not always, and when the ashes are thrown up dry, there is generally such a large condensation of steam and disturbance of atmospheric phenomena that heavy rains occur, and the dust is mixed with those rains and forms mud. Owing to the enormous force with which they are projected into the air, these clouds of dust may be carried along to distances almost inconceivable. The ashes from one of the islands in the Asiatic group were carried on one occasion 300 miles in one direction, and 200 miles in the opposite direction. They probably got into different currents of the atmosphere, and the quantity was so large that the whole of the sky was darkened by them. Ashes have frequently been thrown enormous distances in large deposits. There was a case a little while ago of a deposit 1000 miles from the eruption, which is about such a distance as is Vesuvius from us, and the ground was then covered two feet thick. Occasionally stones have been thrown up into the air, which seen at a distance appeared as large as an ox — an odd comparison, but one used by an observer in Italy. Stones are sometimes carried two miles, sometimes three miles or more, and lifted up into the air vertically many thousand feet. Next comes an enormous quantity of lava, which pours out generally speaking from the sides, though sometimes above the top of the crater. Lava is nothing more than melted rock. It retains its temperature for a considerable time, and being a bad conductor of heat, it cools and hardens at the surface, while the lava flows on under the surface as if through a pipe.

The quantity of lava thrown out at a single eruption is so large, that I feel obliged to mention quantities to give you any idea. An eruption in 1822 of Vesuvius, was sufficiently great for the lava to pour out in two streams, the width of these two currents being somewhere about two miles, and the length somewhere about six miles. You may suppose that an enormous quantity of melted rock had been poured out here, but there have been very much larger quantities than these. Etna in 1852 poured forth an outburst of lava, and during the first twenty-four hours of the eruption the lava had already gone a distance of two miles and a half. That does not appear much to travel, but when you come to consider what it is that travels, a mass of molten rock several feet in depth, pouring steadily on, filling every crevice in its way, completely obliterating a river, engulfing a village, overcoming every obstacle, filling up everything, and therefore completely altering the face of the surface, and at this rate of two and a half miles a day, it is evidently impossible that anything in the shape of buildings can be saved, nor is it at all possible that the current can be diverted. After those twenty-four hours it continued for several days pouring steadily, and the mischief was increased. The disturbance lasted about nine months, and during the whole of that time there were continued minor disturbances gradually becoming smaller and smaller and then terminating altogether. Even this, however, was not large compared with some. The most remarkable on record occurred in Iceland in 1793, and has frequently been described in books, but I mention it to bring it to your recollection. During the very short time that this eruption lasted two distinct streams of lava were poured out, one of them was continued for forty miles, and the other for fifty miles. The width of those currents of lava was many miles, and their depth in some places was as much as from 400 to 600 feet. They filled up all the courses of rivers, obliterated two or three cataracts, in fact altered

the whole face of the country. During this great flow there was much mischief done. The average breadth of one current was twelve miles, and the other seven, there was therefore a total average breadth of nineteen miles, and a total length of nearly fifty miles, with an average thickness of at least 100 feet. It is easy to understand that such an event must have produced a very great impression upon the condition of the interior of the earth, by the mere pouring out of such a large portion. There must have been great cavities left which would afterwards be crushed in from above, or filled in by other matters from below. Such, in a few words, are the results of eruptions in volcanos.

(*To be continued.*)

NOTICES OF BOOKS, PATENTS, &c.

Glycerin and Cod Liver Oil; their History, Introduction, Therapeutic Value, &c.; to which is added a Chapter on Physic taking, or Counsels for the Sick. By W. Burnham Willmott, *Associate of the Pharmaceutical Society of Great Britain, &c. &c.* London: Baillière, 1860.

One difficulty a reviewer sometimes meets with — a perfectly self-imposed one, of course — is to imagine why certain books were ever written. Now this is just the difficulty we have with Mr. Willmott's book. The medical profession we are certain did not want it; the public we are afraid will not read it; and why Mr. Willmott should have been at the trouble of collecting everything he can find at all relating to glycerine and cod liver oil, and a great many things not in the remotest degree connected with them, and tumbling it all into a book together, we cannot guess. He has indeed produced a wonderful specimen of book-making; but we fear the perusal of it will be satisfactory to no single reader. What, for instance, will one of the unprofessional public make of the following quotation from the last edition of Fownes' Manual, which Mr. Willmott introduces? "Glycerin is the type of a triatomic alcohol. It is extremely probable that corresponding alcohols C_2HO_3, 3HO and $C_4H_3O_3$, 3HO will be discovered in the methyl- and ethyl-series. Chloroform, C_2HCl_3, bromoform, C_2HBr_3, and iodoform, C_2HI_3 may in fact be viewed as the hydrochloric, hydrobromic and hydriodic ethers of methyl-glycerin." And if he is not utterly confounded by that, what will he make of our author's paraphrase of the quotation, which immediately follows? "In the foregoing view glycerin is stated to be the type of a triatomic alcohol. Corresponding alcohols may be discovered, the base of which shall be transferred to form the hydrochloric, hydrobromic and hydriodic ethers of methyl- and perhaps ethyl-glycerin. In this formation the metalloids chlorine, bromine and iodine replace the elements of water, and thus furnish in point of fact, triatomic haloid salts of the methyl-series." Probably the unprofessional reader will be ready to agree with a remark the author makes a few pages further on:—"The more we dive into the depths of nature, the more we shall see how infantile in knowledge are the most gifted amongst us, and how much there is that still awaits the aspiring grasp of intellectual greatness."

The chapters on glycerin as a remedy in diseases of the ear, skin and eye, are not unamusing reading. We are sorry to find that glycerine is losing its reputation as a remedy for deafness. "In the more recent works on aural surgery, glycerin is unnoticed; hence we infer that, although it is regarded as an auxiliary in the treatment of deafness, it does not rank so high among aural medicines *as its first brilliant and decisive effects on the human ear* would have led us to anticipate;" but it somewhat consoles us to learn that it "is an agent of great value in the hands of the *dermatological* practitioner." There is not much to be said about the use of glycerine in diseases of the eye, for its employment, as Mr. Willmott says, is limited to the dilution of extract of belladonna: but there is a good deal to be said *à propos de bottes*, or rather the use of belladonna "for the production of brilliant eyes." Here, for instance, is something worth knowing. "If it be required to know the best means of enlarging and beautifying the eye, I would answer, encourage high and noble feelings, read the language of nature, and be ever open to receive impressions which leave behind them traces of the beautiful. It is a principle of physiognomy that 'the exercise of particular attributes of mind produces a more or less development in certain parts of the face.' Thus then, by appropriate mental discipline, the eye may be increased in size, whilst by the exercise of good and happy thoughts it may be increased in brightness and beauty."

The chapter on cod liver oil, we are bound to say, pleases us more than the one on glycerine. Cod liver oil, to be sure, is important as a remedy for consumption, and as Mr. Willmott says, "if this were its *only* claim it would *still* be worthy the attention and unbiassed research of the philosopher and the physician;" and accordingly our author gives a very good account of the oil and its uses, and the various opinions of medical men as to its curative powers, on which it is unnecessary to say they differ as much as on most other subjects.

But it is in the chapter on physic taking that Mr. Willmott is most at home. "Disease," he says, "in various forms, unquestionably exists," and this, he has said, is mainly the consequence of our own indiscretions. "The laws which regulate everything in, around, and upon our terrestrial sphere cannot be broken with impunity. Fire will burn, water will drown, foul air will suffocate, and all the elements of nature combine for good or for ill in proportion as they are used or abused by individuals and communities. Nor is the moral world less certain and less potent in its agency. Thus we find that health and happiness are to a great extent within our reach, providing we can—*consistently with our varied avocations*—observe those laws which are essential to our personal welfare." But we cannot, or do not, and hence the necessity for "physic taking" and Mr. Willmott's "counsels for the sick," which latter are in some respects sensible enough.

CORRESPONDENCE.

The Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—I have just received No. 39 of the Chemical News, and read therein a letter from H. H. The first attack he makes upon the proof I gave of the "Infinite Divisibility of Matter" is grounded upon the hypothesis that the only mechanical difference between solids and fluids is, that in the former their atoms are held more closely together than in the latter. Against any such hypothesis I firmly protest; I do not see that there is any proof to justify such an assertion. Moreover it evidently assumes the existence of atoms, the very thing I do not believe. Again, H. H. says that when I allow two kinds of matter, solid and fluid, I thereupon allow the duality of atoms. I do no such thing—I do not believe in atoms at all. The last argument involves the same unhappy hypothesis as the first does, so I shall not further mention it.—I am, &c.

Thomas S. Barrett.

Exchange of Chemical Specimens.

To the Editor of the Chemical News.

Sir,—I have a suggestion to make which if carried out would I think prove useful to many. It often happens that chemists who have worked on some particular subject have several specimens which they would be willing to exchange for others if they knew any means of communicating with gentlemen whose researches have been directed on other

bodies, and who may also have specimens they would be willing to exchange. I would propose then the formation of a club, by the agency of which these exchanges may be effected.

The machinery may be very simple. Any gentleman who may have specimens he would be willing to exchange need only send his name, with a list of the substances he is willing to part with, and also of those he wishes to have in exchange to the secretary, who would compare the different lists and effect the transfer. If this idea should meet with any encouragement from other correspondents I shall be glad to go more into detail.—I am, &c.

F. C. S.

[Our correspondent's idea is a very good one, and we should be very happy to assist in the object. Our columns would be open for the publication of the lists, and the transfers might be effected at our office.—Ed.]

Chemical Notices from Foreign Sources.

I. Mineral Chemistry.

On Double Decomposition.—According to Schiff[1] when a mixture of chloride of sodium and sulphate of ammonia is strongly heated, hydrochlorate of ammonia volatilises, and sulphate of soda remains behind. An inverse reaction takes place at the ordinary temperature if we mix intimately sulphate of soda and hydrochlorate of ammonia. The mixture, which is dry at first, becomes moist and even changes into a tolerably liquid paste,—the hydrated sulphate of soda in changing to the anhydrous sulphate of ammonia, setting at liberty its water of crystallisation. When solutions of sulphate of soda and sal-ammoniac are mixed, an increase of volume takes place, which may be attributed to a separation of the water of crystallisation; but in the inverse experiment no change of volume is produced, and in one case, with a mixture of chloride of sodium and sulphate of ammonia, an increase of volume took place when there ought to have been a diminution. The author infers that double decomposition in these cases is more or less complete according to the strength of the solutions.

By evaporating very slowly mixtures of sal-ammoniac and sulphate of soda, and of sulphate of ammonia and chloride of sodium, we obtain in both cases for the first crystallisation a double salt $NaAmSO_4 + 2H^2O$.

When finely powdered chloride of sodium and sulphate of ammonia are intimately mixed in the presence of a small quantity of water, the temperature rises and the mass rapidly dries. By an inverse reaction to that mentioned above it is clear that sal-ammoniac is formed, and sulphate of soda, which absorbs water of crystallisation. In this case there is a disengagement of heat, although each of the salts when dissolving alone lowers the temperature.

The carbonate and the phosphate of soda act on hydrochlorate of ammonia like the sulphate of soda.

Formation of Crystals.—Hauer says[2] that when a broken crystal is placed in a solution of an isomorphous salt it quickly recovers its original form; but when a crystal is cut so as to give faces belonging to combinations of the same crystalline system, only these new faces are developed. A crystal with artificial faces placed in a solution of an isomorphous salt behaves exactly like a natural crystal. In this way we may produce mechanically at will any crystalline combinations whatever.

II. Organic Chemistry.

Action of Sulphuric Acid on some Glucosides.

1. *Digitaline.*—M. Kosmann[3] boiled some pure digitaline with dilute sulphuric acid for an hour and a half, and found that a white flocculent matter was precipitated, which, collected on a filter, washed, dried, redissolved in alcohol and evaporated, yielded a yellow resinous crust looking like a lamellar crystallisation. The acid liquor (which was yellow) on being neutralised with lime or baryta and filtered, gave evidence of containing glucose in solution. It reduced the tartrate of potash and copper, and fermented. It seems, then, that digitaline on being boiled with sulphuric acid splits up into glucose and the above mentioned resinous body, which M. Kosmann proposes to call *Digitaliretine*. The mean of several experiments showed the proportions of the two bodies obtained from digitaline to be as follows:—

Digitaliretine	46·67
Glucose	57·41
	104·08

The composition of digitaline and digitaliretine, according to the author's analyses, accord with the following formulæ:—

	C	H	O
Digitaline (anhydrous) . .	54	45	30
Digitaliretine	30	25	10

When purified by redissolving in alcohol and a second evaporation, digitaliretine is obtained in the form of brilliant grains. It is nearly insoluble in water, and but slightly so in ether and cold alcohol. Boiling alcohol dissolves it freely: the solution is bitter, but less so than that of digitaline, and it reddens litmus. It is insoluble in potash, soda, and ammonia; but when acetate of lead, sulphate of iron, sulphate of copper, or nitrate of silver is added to the alcoholic solution, digitaliretates of these metals are obtained.

2. *Santonine.*—When santonine is boiled with dilute sulphuric acid, it likewise splits up into glucose, and a new body which M. Kosmann names *Santoniretine*, which may be obtained in the form of yellowish resinous scales having no taste, are insoluble in water, but soluble in alcohol. The author has not analysed this new body, but supposing that 1 equivalent of santonine assimimilates 4HO in the process, he calculates the composition of santoniretine as $C_{28}H_{18}O_6$.

3. *Guaiacum.*—Guaiacum resin also may be ranked as a glucoside. On boiling with sulphuric acid it yielded glucose, and a deep green coloured resinous matter which the author calls *guaiaretine*, but which he has not analysed.

4. *Resin of Jalap and Scammony.*—The resin of jalap, soluble in ether, called by the author jalapine, obtained from the *convolvulus orizabensis*; and the resin, insoluble in ether, called convolvuline, obtained from the *convolvulus schiedeanus*, furnish resinous matter and glucose when treated with sulphuric acid. The new body procured from the first M. Kosmann calls Jalapinol ($C_{38}H_{30}O_6 + HO$); and that from the second convolvulinol, $C_{36}H_{24}O_6 + HO$. Under the influence of bases these two bodies become acids, each losing the equivalent of water.

The pure resin of scammony, or scammonine, in a like manner breaks up into grape sugar and an electro-negative body which the author names *Scammoneol*, $C_{36}H_{26}$, a homologue of the two former bodies. In conclusion the author alludes to Dr. Williamson's process for extracting the resin of scammony, and expresses an opinion that the resin must necessarily be altered by the action of the acidulated water employed, being thereby changed, partly at least, into glucose and a resin different from the normal resin of scammony.

Miscellaneous.

Professor Way's Electric Light.—The passengers over the Hungerford Suspension Bridge and on the Lambeth strand, on Monday evening last, were enabled to witness the effect of the electric light invented by Professor Way; the brilliant flood from which issued from a window on the north side of the river, bringing into startling relief every

[1] *Annal. der Chem. und Pharm.* Bd. cxiv. s. 68.
[2] *Sitzungsb. der Akad. der Wissenschaf. zu Wien*, Bd. xxxix. s. 641.
[3] *Journ. de Pharm. et de Chimie*, t. xxxviii. p. 5.
[4] *Journal de Pharm. et de Chim.* t. xxxviii. p. 81.

object it encountered. This light differs in character from that produced through electrical agency by means of charcoal points, and from the lime-light, principally in its great volume, appearing, not as a single vivid point, but as a focus of considerable dimensions. It is of an intense white colour with a tinge of green. The effect of its intermission was very striking; the glare of broad daylight being suddenly exchanged for darkness, rendered visible by the moon looking unusually dim and red by the effect of the contrast. Proceeding to the *locale* whence issued the illumination, the arrangements were kindly explained by Mr. Thomas Evans, who had charge of the apparatus, and subsequently by the Professor himself, and we are thus enabled to afford our readers some information respecting the arrangements for producing this light, concerning which little is generally known. A fine stream of mercury, which can be regulated according to the battery power and the volume of light required, passes from an upper into a lower reservoir, and is made to conduct the electric current, by means of which it becomes intensely heated and partly dissipated in vapour. The vaporised mercury becomes subsequently condensed, and proceeds to the lower reservoir, whence it again issues, when the upper reservoir is exhausted and the apparatus reversed. The evolution of light by the passage of the electricity through the fluid conductor appears, however, to be due, not alone to the heating effect, but also, as in the case of the light from charcoal points, to the intensity of the current employed. This fact, which is of interest in explaining the phenomenon which takes place, was pointed out to us by Mr. Fuller, the electrician of the Silvertown Telegraph Cable Works, and was confirmed by an examination of the battery employed, which, contrary to our anticipation, was an *intensity*, rather than a *quantity*, or heating arrangement. The employment of the mercury stream as a conductor fulfils conditions which would probably be wanting in any other substance which could be used for the purpose of obtaining light by similar means. Thus, although some illuminating effect may be produced by heating platinum wire to whiteness by a quantity current, this conductor is deficient in those characters which enable us, by means of tension electricity, to obtain light from charcoal points, interrupted metallic conductors, and the mercury stream of Professor Way. If, on the other hand, we interrupt the wire, we obtain the electric spark which appears in making and breaking contact with mercury; but we fail to produce the heating effect upon the conductor, to which the illuminating power is partly due in the arrangement under notice. It is obvious, moreover, that the constant renewal of the conductor renders it possible to employ a current of any degree of power, and which would be otherwise inadmissible. The vertical mercury stream must be considered as composed of a multitude of conducting globules separated by an imperceptible interval, and thus affording the vivid spark which occurs in making and breaking contact with the metal. This hypothesis affords an explanation of the fact, that an equal illuminating effect cannot be obtained with a *horizontal* stream of mercury, although the latter may be heated to an equal degree. It should be observed, that the apparatus of Professor Way, which may probably before long be employed in lighthouses and for signalling, is rendered air-tight, so as to preclude the possibility of any injurious effect arising from escape of the vaporised mercury.—*The Engineer.*

New Supply of Water to the Metropolis. — A party of scientific gentlemen and others were on Saturday invited to view the gigantic excavations in the chalk formation at Grays, Essex, on the estate of Mr. Meeson, and to receive explanations relative to a proposed scheme for supplying the metropolis with the purest spring water, of which the almost inexhaustible nature of the supply can be estimated from the fact that, from the aggregate of the tiny rills which percolate through the chalk now laid bare by the excavators, a quantity of upwards of two millions of gallons is discharged daily into the Thames as waste. The proprietor of the chalk pits at Grays has been led to consider the expediency of diverting this large diurnal tribute to the already affluent Father Thames to more useful and more profitable purposes, and there seems no reason why copious supplies of pure, refreshing, and wholesome well water should not be admitted to a fair competition with the river water, which—costly and incessant filtration notwithstanding—is known to be loaded with organic impurities, and to the use of which the metropolitan public are almost exclusively confined. It is proposed not only to convey the water through the medium of pipes to London, but also to supply the towns and villages adjoining Grays, which are wofully in want of water, and particularly the outlying suburbs of the eastern part of the capital, where both the quality and the quantity of the supply leaves much to be desired. We believe that every facility can speedily be provided on Mr. Meeson's estate for the due pumping of the water to the requisite height, and the maintenance of an efficient supply and reserve *de die in diem*. Estimates have been made by the eminent engineers, Messrs. Easton, Amos and Sons, for the daily delivery in London of two, four, and six million gallons of water respectively. There are no mechanical difficulties in the way, the excavations being already made, forming as it were impromptu waterworks, and only needing the apparatus of engines, stand-pipes, &c.; and not only the metropolis, but the inhabitants of the lowlands of Essex, between Grays and Stepney, would be much benefited by an amelioration of their water supply. Of the sanitary excellence of the water no doubt can exist; and we believe that Mr. Meeson, with the cooperation of Mr. Miles Beal, will ere long give a more tangible and extended form to the plan to which we have alluded.

[We fear this water will be open to the objections of excessive hardness and imperfect aëration.]

Waterproof Glue. — Fine shreds of india-rubber, dissolved in warm copal varnish, make a waterproof cement for wood and leather. Take glue, 12 ounces, and water sufficient to dissolve it; then add 3 ounces of resin, and melt them together, after which add 4 parts of turpentine. This should be done in a water bath or in a carpenter's glue-pot. This also makes a very good waterproof glue.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Omicron.—Fractional distillation is the only method of separating the different bodies in naphtha. Benzine may be detected by forming nitrobenzole.

A Constant Reader.—Find the hole from which they issue, and pour some boiling water down it.

W. P.—Received.

John Horsley.—Received with thanks.

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THE CHEMICAL NEWS.

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THE ADULTERATION BILL IN THE CITY.

THE City Commissioners of Sewers are deliberating whether or not the Act for Preventing the Adulteration of Articles of Food or Drink shall be adopted in the City of London. So far as we know this is the first place in which the question has been brought forward, and we need not say that the example is most important. On this decision it depends probably whether the Act shall be adopted in all the other metropolitan districts, and perhaps generally throughout the kingdom. We cannot, however, for a moment suppose that the Committee of the Common Council now considering the question will hesitate to recommend the immediate adoption of the Act. It is no doubt only the amount of salary they shall pay their chemist that they are deliberating about —a matter likely to give rise to a good deal of discussion in the City. If an Act for preventing adulteration be not considered necessary in London, for what place on earth can it considered necessary? As the great centre of trade London is necessarily also the great centre of adulteration. It is here that the abomination is committed on the largest scale. Fraud, here, is a wholesale business, and therefore it is here the application of the Act is most imperatively called for. We feel certain that it is unnecessary to say more in support of the adoption. The Act is to be sure a miserable piece of legislation; but if properly carried out it must do some good. In time it is to be hoped we may succeed in getting a much better—an Act that shall include not only articles of food but medicines, and that shall punish all frauds of the nature of adulteration. But for this we shall have to wait. The duty of the City Commissioners, and indeed of all the Metropolitan Boards, now however is perfectly clear; they should appoint their analysts at once, and put the Act in force; and their examples would probably, as we said, be generally followed throughout the country. It would have a very ill appearance if the members of these Boards, who are mostly well-to-do tradesmen, should oppose the introduction of the Act, and in such a case we should recommend their customers to look to the matter.

Since the above was in type, we have been informed that it has been decided not to appoint an analyst in the parish of St. Pancras. We look on this as a bad sign. The paltry saving of a small salary to a chemist is very little to set off against the moral complicity with fraud in its meanest and most shameful form which the refusal involves.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks on Vapour-Densities, by Dr. HOFFMANN.[1]

IN a note addressed to the Academy of Sciences at the end of last year, the author showed that the molecule of the diamines, like that of all other well examined compounds, corresponds to two volumes of vapour. At the same time he endeavoured to explain the apparently abnormal vapour-densities of the hydrated diamines by supposing that the vapours given by these substances are really mixtures of the vapour of the anhydrous base and the vapour of water. Thus it is admitted that the hydrate of ethylene-diamine splits up under the influence of heat into anhydrous ethylene-diamine (2 vols.) and water (2 vols.).

$$C_2H_{10}N_2O = \left\{ \begin{matrix} (C_2H_4)'' \\ H_2 \\ H_2 \end{matrix} \right\} N_2 + \left\{ \begin{matrix} H \\ H \end{matrix} \right\} O$$

The vapour density of ethylene-diamine in relation to that of hydrogen being 30, and that of water being 9, the density of a mixture of equal volumes of these two substances —

$$= \frac{30+9}{2} = 19{\cdot}5$$

a number which exactly coincides with the experimental result.

In continuing the study of the diamines the author has remarked numerous analogous facts; but without going into the details of the researches, he now brings forward an observation which appears to decide the question experimentally.

Ethylene-diamine, when submitted to the action of iodide of ethyl, gives a series of ethylic derivatives among which the author has particularly studied the diethylic base. This body, in the anhydrous state, is a liquid containing

$$C_6H_{16}N_2 = \left\{ \begin{matrix} (C_2H_4)'' \\ (C_2H_5)_2 \\ H_2 \end{matrix} \right\} N_2,$$

and forming a well crystallised and very stable hydrate of the composition

$$C_6H_{18}N_2O = \left\{ \begin{matrix} (C_2H_4)'' \\ (C_2H_5)_2 \\ H_2 \end{matrix} \right\} N_2 + \left\{ \begin{matrix} H \\ H \end{matrix} \right\} O.$$

Experiment shows the vapour-density of the anhydrous base to $=57{\cdot}61$, which proves that the molecule of the diethylic ethylene-diamine corresponds to two volumes of vapour, the theoretical density being

$$\frac{114}{2} = 57.$$

On determining the vapour-density of the crystalline hydrate it was found to $=33{\cdot}2$, a number perfectly in

[1] *Comptes-Rendus*, t. li. p. 236.

accordance with the result obtained in the case of the ethylene-diamine itself. In this case again the natural interpretation of the number leads us to admit that the hydrated base is decomposed into the anhydrous diamine and water, and that the observed density is that of a mixture of equal volumes of the vapour of the diamine and of water, which mixture would give a density,

$$=\frac{57+9}{2}=33.$$

The truth of this explanation may be demonstrated by a very simple experiment. Having observed that the hydrate lost its water when repeatedly distilled with a large excess of baryta, the author was led to attempt the decomposition of the hydrate in a state of vapour. If the vapour obtained by heating this substance about 20° above its boiling point, was really a mixture of equal volumes of the vapours of the base and of water in a state of *dissociation*, to use a happy expression of M. Deville, it was very probable that the vapour would be reduced to half by the action of anhydrous baryta. Experiment has verified the expectation.

The upper part of a glass tube filled with mercury and inverted in the trough was surrounded by another tube open at the two ends, and having a diameter about three times that of the first tube; the annular space between the two being closed at the lower part by a well fitting cork. The vessel thus formed around the inner tube is furnished besides with a tube of copper open above and closed below, and fixed also in the cork. The vessel being filled with paraffine, and the copper tube being heated by a lamp, it was easy to keep the upper part of the tube containing the mercury at a high and constant temperature, while the lower end which dipped in the trough was unaffected. After having raised to the top of the tube a small quantity of the hydrated base and heated the paraffine, the volume of the vapour furnished was observed. After that some fragments of anhydrous baryta were introduced into the tube still maintained at the temperature of the bath. As soon as the baryta reached the vapour the mercury began to ascend, and only remained stationary when the vapour had diminished (the necessary corrections having been made) to half its original volume.

Notes on some of the Chemical Reactions of Narcotine and Meconic Acid, by T. G. Wormley, *M.D.*

(*Concluded from page 159.*)

XIII. Iodine in Iodide of Potassium.—1. $\frac{1}{100}$th, gives a copious red-brown amorphous precipitate, which is soluble in several drops of strong acetic acid, but not readily, in a large excess of potash. An excess of reagent should be used, otherwise the precipitate first produced will be dissolved.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{10000}$th, a brownish precipitate, which dissolves in a drop of potash solution without the production of a white one as in strychnia.

4. $\frac{1}{20000}$th, a brown yellow precipitate, quite copious.

5. $\frac{1}{30000}$th, a good green yellow precipitate.

6. $\frac{1}{100000}$th, by allowing a drop of the reagent to flow into the narcotine solution, a very perceptible precipitate is produced.

7. $\frac{1}{200000}$th, in about half a minute, the precipitate is quite obvious.

8. $\frac{1}{300000}$th, the precipitate is still perceptible.

XIV. Bromine in Bromohydric Acid.—1. $\frac{1}{100}$th, gives a copious bright yellow precipitate, which soon dissolves if there is not an excess of reagent.

2. $\frac{1}{1000}$th, the precipitate is readily soluble in potash, but is immediately replaced by a white one.

3. $\frac{1}{10000}$th, much the same as 2, but only a trace of white precipitate.

4. $\frac{1}{20000}$th, a dirty yellow precipitate.

5. $\frac{1}{30000}$th, gives a green yellow precipitate.

6. $\frac{1}{150000}$th, gives a quite obvious precipitate.

7. $\frac{1}{200000}$th, the precipitate is still perceptible.

XV. Sulphuric and Nitric Acid.—1. $\frac{1}{100}$th grain of narcotine, when acted upon by a small drop of strong sulphuric acid, dissolves with a yellow solution, if now a small crystal of nitrate of potash be added, the crystal becomes blood red, which after a time dissolves, giving a blood red colour to the solution, which after a time changes to orange. If the nitrate of potash be first dissolved in the acid, and then the mixture be allowed to flow upon the narcotine, the deposit immediately becomes blood red, and slowly dissolves, giving a solution of the same colour.

2. $\frac{1}{1000}$th, dry; if the mixture of sulphuric acid and nitre be allowed to flow upon the deposit, it immediately becomes blood red, and soon dissolves giving a yellow solution.

3. $\frac{1}{10000}$th, the deposit becomes red, but very soon dissolves with a yellow solution.

4. $\frac{1}{20000}$th, gave no indication.

XVI. Sulphuric Acid and Bichromate of Potash.

2. $\frac{1}{100}$th, when the dry residue is dissolved by a drop of strong sulphuric acid, it gives a yellow solution, which when treated with a very small crystal of bichromate of potash changes to a wine colour, which remains permanent for days; if an excess of the potash salt be used, the mixture passes through several colours and ultimately becomes blue. The permanent colour is readily obtained by stirring the potash crystal in the acid solution of the narcotine till it imparts a wine colour, and then removing the crystal from the solution.

2. $\frac{1}{1000}$th, if a small crystal of the potash salt be stirred in a drop of sulphuric acid till it imparts a distinct colour, and then the mixture be allowed to flow upon the narcotine, the deposit becomes red or brown, and then dissolves with a colour dependent upon the amount of potash salt used.

3. $\frac{1}{5000}$th, the deposit gives a brown colour.

The change of colours observed in the application of this test might cause the inexperienced to mistake narcotine for strychnia.

Meconic Acid.

When necessary, the meconic acid was dissolved by the aid of a gentle heat.

I. Sesquichloride of Iron.—1. $\frac{1}{100}$th, grain of meconic acid in one grain of water, will give with a solution of sesquichloride of iron, an immediate blood red solution, the colour of which is not affected by several drops of a solution of corrosive sublimate or chloride of gold.

2. $\frac{1}{1000}$th, much the same as 1.

3. $\frac{1}{10000}$th, gives a decided red colour to the solution, which when compared with a drop of the reagent is very marked.

4. $\frac{1}{20000}$th, gives a faint red solution, but not satisfactory; if several drops of the meconic acid solution be used, the colour is very decided.

If the meconic acid solution be evaporated to dryness and the reagent applied to the residue,—

1. $\frac{1}{10000}$th, the deposit becomes deep blood red.

2. $\frac{1}{20000}$th, the red colour is very distinct.

3. $\frac{1}{5000}$th, the colour is just perceptible.

It is well known that several other substances beside meconic acid give much the same reaction with sesquichloride of iron, those most likely to be met with are the sulphocyanides, or acetates, or their acids. The colour produced by the sulphocyanides is immediately discharged by a solution of corrosive sublimate, whereas the colour developed by meconic acid is unaffected; again, the colour produced by acetic acid or acetates is not discharged by corrosive sublimate, in this respect it agrees with meconic acid, however, the colour produced by one drop of $\frac{1}{5000}$th solution of meconic acid, is more intense than that produced by a drop of concentrated acetic acid; the colour of the meconic acid is discharged by a drop of sulphuric acid, with the evolution of much gas, whereas that produced by acetates is destroyed without the production of gas.

II. Acetate of Lead.—1. $\frac{1}{100}$th, gives with this reagent an immediate yellow white amorphous precipitate, which is insoluble in acetic, but readily in nitric acid.

2. $\frac{1}{1000}$th, gives a bluish precipitate.

3. $\frac{1}{20000}$th, in a few seconds a distinct opalescence, which in a little time collects into little flocks.

4. $\frac{1}{50000}$th, in a few minutes a distinct opalescence, which after a time collects into little bluish flocks.

There are many other substances which produce with acetate of lead white precipitates much the same as those produced by meconic acid, of these we may mention: 1. Sulphocyanides; these give a pure white precipitate, soluble in acetic acid, and when from dilute solutions, readily in nitric acid. 2. Chlorides; a white precipitate, which when from chloride of sodium, will readily dissolve in excess of reagent, acetic, or nitric acid; if the precipitate be due to free chlorine, it will not readily dissolve either in acetic or nitric acid. 3. Sulphuric acid, or sulphates; the precipitate is insoluble in acetic, and sparingly in nitric acid. 4. Soluble carbonates; a white precipitate soluble with effervescence in acetic acid. 5. Phosphates; insoluble in acetic, but soluble in nitric acid. 6. Oxalates; same as phosphates. Of the above substances, it will be observed that the precipitates produced by sulphocyanides, chlorine, and carbonic acid, are soluble in acetic acid; that produced by sulphuric acid, is insoluble in acetic and nitric acid; those from phosphoric, oxalic, and meconic acids are insoluble in acetic, but soluble in nitric acid; chloride of calcium will give a white precipitate with either a phosphate or oxalate, but none with meconic acid.

Another method of distinguishing the meconate from the sulphocyanide of lead, is to add to the precipitate a few pieces of zinc, and then a few drops of sulphuric acid, when the meconate mixture will evolve pure hydrogen, whereas, the sulphocyanide will yield sulphuretted hydrogen.

III. Sulphate of Copper.—2. $\frac{1}{100}$th, gives an immediate copious green precipitate, which is soluble in excess and in acetic acid.

2. $\frac{1}{500}$th, a slight precipitate which increases by standing, collecting in little bluish flocks.

IV. Nitrate of Silver.—1. $\frac{1}{100}$th, gives a white amorphous precipitate, readily soluble in ammonia, but insoluble in acetic acid.

2. $\frac{1}{1000}$th, in a few seconds a dirty white precicipitate.

3. $\frac{1}{5000}$th, after a little time a slight opalescence, which improves by standing.

V. Chloride of Barium.—1. $\frac{1}{100}$th, after a little time, especially if stirred, a granular and crystalline precipitate, the crystals are of various forms and characteristic, many of them being dumb-bell shaped. In solutions much more dilute than the above the reagent gave no indication.

VI. Ferricyanide of Potassium.—1. $\frac{1}{100}$th, after a little time, especially if stirred, green yellow hair-like crystals appear, which after a little while are abundant, these crystals are very characteristic. The ferrocyanide of potassium gives the same form of crystal, but they are much more slow to appear.

2. $\frac{1}{500}$th, no indication after some time.

Meconic acid dissolves in sulphuric acid without change of colour, if then a crystal of bichromate of potash be stirred in the mixture it becomes a slight green.

None of the various tests given for narcotine, except those stated, will give a precipitate with meconic acid.

TECHNICAL CHEMISTRY.

Excise Chemistry.—Report on the Laboratory, by Mr. G. Phillips.

(*Concluded from page 163.*)

Coffee.—Whilst it is strictly forbidden that tobacco, tea, pepper, and other articles subject to fiscal duties, should be sold except in a state of purity, or at least as imported and passed by the customs, coffee has for many years been permitted, under certain regulations, to be sold mixed with a substance, chicory, which affords a beverage somewhat resembling, but inferior to, that derived from coffee — yields but little return to the revenue — and is not worth one third of the article it supplants. Under these circumstances, brought about partly by the representations and efforts of the dealers in ground coffee, and partly by the fact that a taste for the mixture had been gradually acquired by a section of the community, it obviously became necessary to adopt measures to protect the revenue, and to prevent that portion of the public which preferred purchasing pure coffee from being imposed upon, under cover of the indulgence allowing mixtures of coffee and chicory to be sold. Accordingly it has been the practice of the revenue to cause annually several thousands of samples to be purchased, indiscriminately, for analysis, from coffee dealers throughout the United Kingdom, and to institute proceedings against all persons found infringing the fiscal regulations which govern the sale of coffee. The mixing of coffee with chicory is as much an adulteration as the addition of sloe leaves or tannin to tea, or of sugar to tobacco, under the plea that these articles would be thereby improved; and it may be a question whether the revenue and the public, and ultimately the dealers themselves, would not be benefitted by prohibiting entirely the sale of mixtures of chicory and coffee, leaving the customers to purchase the two substances, and to mix them according to their own taste.

The per centage of chicory present in mixtures of chicory and coffee sold unlabelled has risen from 26·7 in 1857 to 39·8 in the year just ended; the quantity of chicory contained in such mixtures sold in Ireland averaged not less than 59 per cent.

Beer and Hops.—In adulterating beer, the fraudulent brewer or retailer aims at increasing his profits by the adoption of one or both of two distinct methods, that is, either by simply increasing the bulk of his beer by the addition of some other liquid, or by rendering the beverage more intoxicating and thirst-exciting, giving to it, by the use of certain chemicals or drugs, a false appearance of strength, and a bitter not due to the hop. In the first method, which is the best adapted to

the purposes of the dishonest retailer, the substances added to the beer are, usually, saccharine matter, water, and salt; whilst in the second method, which is oftener adopted by brewers than by retailers, the illicit materials most commonly resorted to are grains of paradise, and, as a substitute for hops, quassia, gentian, chiretta, and wormwood. It is supposed from the large quantity of Cocculus Indicus imported, for which no legitimate purpose can be assigned, that it is used in the adulteration of beer; but only one detection of the kind has been made within the last seven years.

In my former reports I alluded to the great difficulty in establishing conclusively, by chemical analysis, the fact that a sample of beer is adulterated. In some few cases this can be done, but although the analyst may often feel certain that a fraud has been committed, the proofs obtained are not sufficiently strong to satisfy a court of justice, or even to justify a prosecution. For the detection of many forms of adulteration no satisfactory process is known; the whole subject requires investigation; and I purpose, on the first opportunity, causing experiments to be made in the laboratory with a view to render more easy and certain the detection of illicit materials in beer.

Within the past year only three samples of beer — all of which proved to be genuine — were sent to the laboratory for analysis. During the same period six samples of spent hops were also examined, five of which were adulterated, three with grains of paradise alone, one with the addition of ground roasted chicory, and one with Calamus aromaticus (sweet flag). Besides these a few samples of adulterating substances found on brewing premises have been analysed.

Roasted Malt.—The practice of roasting raw barley to the almost entire exclusion of malted grain, which was very general four years ago, is now, owing to the operation of the Act 19th and 20th Vict. c. 34, in a great measure suppressed, and it is satisfactory to be enabled to state, that although at one time the malt roasters in London carried on the obnoxious practice, in some cases to its utmost limit, being induced to do so in self-defence by the competition of fraudulent roasters in other parts of the country, they have, throughout the past year, been working fairly, and in no instance has it been necessary to institute proceedings against them. In Ireland, some roasters have persisted in mixing ungerminated grain with their malt; but even here some improvement has been perceptible, as the average per centage of illegal grain present in the samples examined is considerably less than that found in the samples taken in 1858.

Beer exported on Drawback.—The large quantity of beer exported during the year just ended, and the fact that in all shipments, however small, the beer is now tested as to its strength, have caused that portion of the business of the Laboratory which consists in determining original gravities to be nearly double what it was in the year 1858, the number of samples examined within the past year amounting to 4780, which number is increased to 4928 by experiments repeated, and the examination of duplicate samples.

The truthfulness of the mode of ascertaining original gravities practised by the revenue is now but seldom disputed, and when such is the case it is generally found that those who demur have had but little experience in brewing beer for exportation, and consequently have not been in the habit of having the strength of their finished beers rigorously tested. The large brewers appear to admit that the mode in question is fair, and whilst some of them brew their beer so that the original gravity is only slightly greater than that at which it is declared on exportation, it very rarely occurs that their beer is disentitled to the drawback claimed.

Wood Naphtha.—The fact that spirits of wine, when rendered non-potable by the addition of wood spirit, may be safely permitted to be used, duty free, in the arts and manufactures, without injury to the revenue, appears to be well established; and I am not aware that any one has succeeded in obtaining a potable spirit from the mixture in question. Efforts have unquestionably been made to separate the two spirits, but not so much, I believe, to produce a drinkable spirit, as to obtain from methylated alcohol spirits of wine sufficiently pure for certain chemical and pharmaceutical operations for which the methylated spirit is not well adapted.

The wood naphtha used for methylating alcohol is always tested in the Laboratory in order to determine whether or not it is suitable for this purpose, and in the year just ended 47 samples have been so examined.

Miscellaneous Samples.—The number of samples of a miscellaneous description analysed in the laboratory during the last twelve months amounts to 75, of which 14 were from the Customs. They comprised foreign and British wines, cordials, imitation wines containing no alcohol, ginger beer, fruit essences, "finish," breakfast powders, cocoa, cane sugar, molasses, glucose, vegetable juice, syrups, teas, dyes, essential oils, and exotic flowers.

Total number of Samples analysed in the Laboratory in each of the years 1857, 1858, *and* 1859.

Description of Samples.	Number of Samples examined in		
	1857.	1858.	1859.
Tobacco	46	73	57
Snuff	44	99	11
Pepper	28	56	99
Beer, and Substances used in its adulteration	14	10	6
Hops which have been used by Brewers	7	11	6
Tea	5	4	5
Coffee	4624	3505	3470
Coffee and Chicory	315	228	742
Malt	221	54	143
Beer (original gravities)	1049	2550	4928
Distillers' Wash	—	25	42
Wood Spirit	50	41	47
Miscellaneous Samples	60	110	75
	6463	6766	9631

Excise Laboratory, March 31, 1860.

On the Preparation of Artificial Colouring Matters with Products extracted from Coal Tar, by M. E. Kopp.

(*Continued from page* 149.)

Extraction of Aniline from Coal Tar.—The method which appears to be the most rational, and which deserves to be tried, would consist in treating the tar as condensed in gas works, with hydrochloric or sulphuric acid, diluted with 3 or 4 times its volume of water. Mechanical means for affecting the intimate mixture of the tar with the acid might be easily contrived, but in the absence of any special contrivance, the end may be attained by half filling a barrel with the tar,

adding one-fifth or one-sixth its volume of acid, and rolling and shaking the barrel until the acid has taken up all the bodies with which it is able to combine; the whole might then be run into a cistern, where by degrees the watery liquid would separate from the tar. The same acid liquid might be used over and over again, until the bases had nearly saturated the acid. A very impure aqueous solution would thus be obtained, but containing the hydrochlorates or sulphates of ammonia, and all the other organic bases contained in the tar, such as aniline, quinoline, pyrrol, picoline, pyrrhidine, lutidine toluidine, cumidine, &c. By evaporating this solution almost to dryness, and then distilling with an excess of milk of lime, the bases would be set at liberty. Ammonia, as the most volatile, would be disengaged first, and might be condensed apart, and by raising the temperature higher and higher the other bases would be disengaged. Aniline would be found among the liquids distilling between 150° and 250° C.

The manipulation of the tar, however, is an extremely disagreeable operation, and presents many difficulties; it is therefore preferable, in most cases, to distil the tar first, and only operate on the most pure and limpid distilled oils.

Aniline, because of its high boiling-point, is never met with in the light and volatile liquids which first distil from tar. The most of it is found in those which distil between 150° and 230° C. These, according to Hofmann contain about 10 per cent. of organic bases, mostly aniline and quinoline. The oils which distil above 250° contain mostly quinoline, and very little aniline.

The following is Hofmann's process for extracting the two bases from the oils and separating them. The oil is agitated strongly with commercial hydrochloric acid. The mixture is then allowed to rest for 12 or 14 hours, and the oil is separated from the acid; the latter is treated again with fresh quantities of oil until it is nearly saturated. The still acid solution of the hydrochlorates is filtered through linen or wetted filtering paper, to retain the greater part of the oil mechanically mixed with the watery solution; it is then placed in a copper still, and supersaturated with an excess of milk of lime. At the moment of saturation an abundance of vapours are given off, and the head must be quickly fixed on the still. Heat is now applied, so as to obtain a quick and regular ebullition.

The condensed product is a milky liquid, with oily drops floating on it. The distillation is carried on as long as the vapour has the peculiar odour of the first part distilled, or the condensed product gives the characteristic reaction of aniline with chloride of lime.

The milky liquid is now saturated with hydrochloric acid; it is then concentrated in a water bath; and lastly, decomposed in a tall narrow vessel by means of a slight excess of hydrate of potash or soda. The bases set free, unite, and form an oily liquid, which floats on the alkaline solution. This is removed with a pipette and rectified. The rectified product is aniline, sufficiently pure for industrial purposes, especially if we set aside the part distilling above 200° or 220°, which is principally composed of quinoline.

To obtain aniline chemically pure, the neutral oils forming part of the oily layer must be completely removed. This is done by dissolving the whole in ether, and adding dilute hydrochloric or sulphuric acid, which combines with and separates the bases, and leaves the oils in solution in the ether. The acid solution is then decanted, decomposed with potash, and submitted to careful fractional distillation. If the products are gathered separately in three parts, the first will contain ammonia, water, and some aniline; the second will be pure aniline; while the third portion will contain mostly quinoline. An alcoholic solution of oxalate acid is now added to the impure aniline, which precipitates oxalate of aniline, as a mass of white crystals, which are washed with alcohol, and then pressed. The salt is then dissolved in a small quantity of water, to which a little alcohol is added. From this solution the oxalate crystallises in stellated groups of oblique rhomboidal prisms. These crystals are decomposed by a caustic alkali, to set free the aniline, and when this is distilled, water at first passes, then water charged with aniline, and lastly, at 182° C. chemically pure aniline.

Artificial preparation of Aniline by the reduction of Nitro-benzole.—This process which constitutes one of the most curious and important reactions of organic chemistry, allows us to obtain aniline in any quantity. It is not difficult to prepare, but certain precautions are necessary when operating on a large scale.

The process may be subdivided into three distinct operations.

1. *Preparation of Benzole.*
2. *Transformation into Nitro-benzole.*
3. *Reduction of Nitro-benzole to form Aniline.*

1. **Preparation of Benzole.**—The only process we have space to notice is that by which benzole is obtained on a large scale, viz.—the extraction from coal-tar, or from the first products of the distillation of coal-tar, light oil, or crude naphtha.

The manufacturer who wishes to distil tar in order to procure the largest amount of benzole, should choose a light fluid tar, and preferably one distilled from bog head or cannel coal. To form a comparative estimate of the value of different tars, the following experiment may be performed:—About 20 pints of the tar are distilled until the vapours, instead of condensing into a liquid, furnish a product which, on cooling, becomes solid, or of a buttery consistence. By carefully observing when the condensed oil becomes heavier than the water, and measuring the volume of the lighter oils which float on the surface of the water, and then comparing the volumes, we are enabled to estimate with tolerable accuracy the value of the tar. Of course that which yields the largest amount of light oil is the best.

Some account of the process of distillation was given at pages 124 and 148 of this volume, to which we refer the reader, and also to the paper by Mr. Mansfield, in the *Quarterly Journal of the Chemical Society*, i. p. 244.

Crude naphtha, or the benzole of commerce, is generally a yellow or brown liquid, having a density varying from ·90 to ·95; it usually contains, besides benzole, some of the homologues of benzole, toluol, cumol, and cymol. It is impossible to separate these bodies by an ordinary process of rectification; for although the boiling point of toluol is 108° or 109°, and that of cumol 143° or 145°, their vapours are, so to say, dissolved in the vapour of benzole, and are carried over and condense together. Their presence, however, need not interfere with the preparation of nitro-benzole and aniline.

The benzole found in commerce is at times very impure; some, indeed, has been met with containing but a trace of real benzole. Such an article is generally the result of the distillation of bituminous schists or asphaltum; and, besides hydrocarbons belonging to another series than that of benzole, it generally contains a small amount of oxygenated products, and consequently can-

not be advantageously used in the preparation of aniline. It is therefore important to be able readily to detect benzole in a mixture of other oils. For this purpose we may avail ourselves of the facility with which true benzole is converted into nitro-benzole and then into aniline by the action of nascent hydrogen.

The following is Hoffmann's method:—A drop of benzole is heated in a small test tube, with fuming nitric acid, to convert it into nitro-benzole. A good deal of water is then added, to precipitate the nitro-benzole in small drops, which must be taken up by ether. The etherial solution is then poured into another small tube, and equal volumes of alcohol and dilute hydrochloric acid are added; a few fragments of granulated zinc are then dropped in. In about five minutes sufficient hydrogen will have been disengaged to produce aniline, which will be found combined with the acid. The liquid is supersaturated with an alkali and shaken with ether, which dissolves the aniline set free. A drop of this etherial solution allowed to evaporate on a watch glass, and mixed after the evaporation of the ether with a drop of a solution of hypochlorite of lime, will show the violet tints which characterise aniline. The operations may be executed very rapidly, and without any difficulty.

Properties of Benzole. At the ordinary temperature benzole is seen in the form of a colourless very fluid liquid, of an agreeable (?) odour, and having the specific gravity ·85° at 15° C. At a very low temperature it crystallises or forms a mass like camphor, which melts at 5°. Its boiling-point is between 80° and 81°, and it distils without undergoing any change. It is nearly insoluble in water, to which, however, it imparts its peculiar odour; it is very soluble in wood-spirit, ether, alcohol, the essential and the fatty oils; and it easily dissolves camphor, wax, fatty matters, india-rubber, gutta-percha, and a great number of resins. Among the the last, those which are least soluble in it are shellac, copal, and animi. It is very inflammable, and burns with a brilliant smoky flame. Hydrogen gas passed through it, and charged with its vapour, burns with a very clear, luminous flame.

Chlorine and bromine convert benzole into the terchloride and terbromide of benzole. In direct solar light the change takes place very quickly. Concentrated sulphuric acid dissolves benzole, and when the mixture is gently heated, a copulated acid, sulpho-benzylic acid, is formed, $C_{12}H_6S_2O_6$, the hydrogen of which may be replaced by metals. As this acid is soluble in water, we see that in purifying rough benzole with sulphuric acid it is necessary to avoid using an excess of the acid, and also heating the mixture. A solution of chromic acid does not act on benzole, and is therefore a good agent for the purification. Concentrated nitric acid converts benzole into nitro-benzole, to the manufacture of which we next proceed.

(To be continued.)

Phosphated Bread, by Professor E. N. Horsford, *Philadelphia.*

My attention was called, five years since, to the necessity of a substitute for cream of tartar, as an article of domestic consumption. It was represented to me by extensive dealers that the production of cream of tartar was no longer equal to the demand, and that the greatly increased consumption in the arts and for culinary purposes, had caused its price to rise, until it seemed possible that for some important purposes its further use must be given up. It was also stated that its high price had led to frequent adulterations, some of them of more than questionable character in their relations to health. Upon these representations I undertook the solution of the problem as one of great public importance.

Among the essential qualities of a substitute for cream of tartar, in the preparations of all forms of light bread, cakes and pastry, are that the article should be at least as unobjectionable as cream of tartar in its relations to the animal economy—that it should be pulverulent—and that when mixed with bicarbonate of soda and flour, it should, on the addition of moisture or application of heat, yield a neutral salt, and set free carbonic acid. If, in addition to these qualities, an article could be devised which should possess, in the form in which it is used, unquestionable excellence as an element of food, its value would be placed beyond doubt.

I tried in a great variety of ways, as numerous others have tried, without success, to find some form of muriatic acid which could be mixed with bicarbonate of soda, so as, after raising the dough or paste, common salt should be found in the product. To this most desirable end insuperable difficulties presented themselves. I sought some form of harmless organic acid, suited to all the conditions of the problem, but this effort and many others were alike fruitless. At length it occurred to me to find, if possible, an acid constituent present in all the cereals and healthful food, and place this in the necessary conditions to fulfil the wants of the problem, and, at the same time, in such form that when taken into the system it would be suited to the agencies there in action, to be absorbed, if needed, or readily and healthfully removed if not required. Of all such constituents no one is so important as phosphoric acid. Physiological and chemical research have shown that wherever in the body there is an organ of important functions, there nature has provided a store of phosphates. They are present in the juices, the tissues, the muscles, and in large measure in all the brain and nervous matter, and in larger measure still, in the bones. The grains we consume contain them. The flesh we eat contains them. The bones we boil and dissolve contain them. The French army was formerly supplied with rations of dissolved bone, prepared at high temperatures in Papin's digester, in the form of small cakes, which a little hot water resolved into soup. The bran which we withdraw from our wheat contains fourteen times as much phosphoric acid as the flour which we convert into bread. The natural provision in the animal economy for the removal of surplus phosphates, as in the waste and renewal of the bones, is well known.

All these considerations led me to the conviction that if it were possible to prepare phosphoric acid in some form of acid phosphate of lime, such that, after its action with moist carbonate of soda, it would leave phosphate of soda (a constituent of the blood) and phosphate of lime (an essential constituent of food), and confer upon it the necessary qualities of a dry, pulverulent acid, the end would be so far attained as to justify a practical experiment in domestic use.

I succeeded in producing the article in condition to meet the wants of the problem. I then introduced it into my family for use in all forms, as a substitute for cream of tartar for culinary purposes. When many months of daily use had assured me that my theoretical views were sustained by practical application, I gave it into the hands of friends, whose prolonged experience fully confirmed my own. It has been in constant use in my family now for more than four years; and in the

form of yeast powder, during this time, it has been produced and consumed in all parts of the country to a very large extent, settling, in the most satisfactory manner, all questions as to its serviceability and healthfulness.

Dr. Samuel Jackson, professor of the Institute of Medicine in the University of Pennsylvania, gives the following testimonial in support of these views:—

"Your substitute for cream of tartar for the raising of bread is a decided improvement. The tartaric acid is not a constituent of the grains from which flour is made; it is not a nutritive principle, and often disagrees with the alimentary organs. The phosphate of lime, which is the principal ingredient of your preparation, is an essential constituent of all grains. It is further an important nutritive principle; and recent experiments have proved it is an indispensable element in the construction, not of bones only, but of all the animal tissues. A deficiency of the phosphate of lime in food is a common cause of ill health, of defective development and retarded growth in children. In the conversion of wheat into flour, the phosphate of lime is rejected with the bran; and, in consequence, this necessary element of nutrition, contrary to the arrangement of nature, is not obtained from our fine wheat bread. Your preparation, while it makes a light, sweet, and palateable bread, restores to it the phosphate of lime which has been separated from the flour, and thus adapts it as an aliment for the maintenance of a healthy state of the organisation."—*Scientific American.*

PHARMACY, TOXICOLOGY, &c.

On the Preparation of Hypophosphorous Acid and the Hypophosphites.

Few of the recent introductions to our Materia Medica have had such an extensive sale and have risen so steadily in professional favour as the salts of hypophosphorous acid. It is no part of our duty to express any opinion of their value as medicines, but the constant and increasing demand for them induces us to lay before our pharmaceutical readers some account of their preparation, and the various combinations in which they are now prescribed.

Hypophosphorous acid, PO, a compound of one equivalent of phosphorus and one of oxygen, has not yet been prescribed in a free state; but inasmuch as it contains a larger proportion of phosphorus than phosphoric acid, it would appear to be better adapted than the latter acid for the purposes for which it is administered. We shall therefore give directions by which the acid may be prepared of a convenient strength for medicinal use.

Hypophosphorous acid is formed when phosphorus is gently boiled either with milk of lime, baryta water, or a solution of potash. The best way is first of all to prepare hypophosphite of line in the following way[1]:—

Take of	lime recently burned	4 lbs. av.
„	phosphorus	1 lb. av.
„	water	5 gallons.

Slake the lime with a gallon of the water, put the remainder in a deep boiler, and as soon as it boils add the slaked lime and mix. The phosphorus is now added, and the boiling is kept up, constantly adding hot water from time to time, so as to preserve the measure as near as may be until all the phosphorus is oxidised and combined. During this process there is a continual evolution of spontaneously inflammable phosphuretted hydrogen gas, which explodes as it reaches the atmosphere, forming water and phosphoric acid. When the strong odour of phosphuretted hydrogen ceases to be given off the solution is filtered and the residue is washed. The residue is composed of the excess of lime and phosphate of lime, into which latter salt nearly half the phosphorus is converted. The solution and washings are then concentrated, and again filtered to remove a small quantity of carbonate of lime which has been formed by the action of the air on the lime in solution. The concentrated liquid is now evaporated until a pellicle forms, when the hypophosphite of lime crystallises; or the heat may be continued, the liquid being constantly stirred, until the salt is obtained in a granular form.

A modification of the above process by Scheffer has the advantage of avoiding waste by the formation of phosphate of lime, and also of preventing the liberation of so much of the offensive phosphuretted hydrogen. He first fuses the phosphorus under water, and then oxidises it by pumping in atmospheric air. The phosphorus burns somewhat and swells up, being partially converted into oxide of phosphorus, P_2O, and now readily combines with the lime on being heated to 130° F. the gas given off being chiefly hydrogen.

Hypophosphite of lime crystallises in flattened prisms, which have a pearly lustre. Its composition is expressed by the formula 2HO,PO,CaO. It is soluble in six parts of cold water, and in about the same quantity of boiling water.

Hypophosphorous acid may be prepared from hypophosphite of lime by separating the lime by means of oxalic acid. The following proportions give an acid of a convenient strength[2]:—

Take of	hypophosphite of lime	480 grains
„	oxalic acid	350 „
„	distilled water	9 fluid ounces.

Dissolve the hypophosphite of lime in six ounces of the water, and the oxalic acid in the remainder with the aid of heat; mix the solutions, filter, and when the liquid has passed add water to make up eight and a half fluid ounces. The solution thus prepared contains about 10 per cent. of the terhydrated hypophosphorous acid 2HO.PO+HO. A teaspoonful represents six grains of the acid, which contains two and a quarter grains of phosphorus. The dose of the solution will probably vary from ten minims to a teaspoonful.

Most of the hypophosphites are best prepared from the lime salt by double decomposition.

Hypophosphite of Soda.[3]

Take of	hypophosphite of lime	6 ounces
„	crystallised carbonate of soda	10 „
„	water	a sufficient quantity

Dissolve the hypophosphite in four pints of water, and the carbonate in a pint and a half. Mix the solutions, throw them on a filter, and wash until the filtrate measures six pints. Evaporate the liquid until a pellicle forms, and then stir constantly, continuing the heat until the salt granulates. If crystals be desired, dissolve the granules in alcohol, evaporate until the solution is syrupy, and then set aside in a warm place for crystals to form.

Hypophosphite of Potash.—This salt is prepared in the same way as the soda salt, five and three quarter ounces of carbonate of potash being substituted for the carbonate of soda.

[1] Parrish's *Practical Pharmacy*, p. 499.

[2] *Ibid.* p. 501.

[3] *Ibid.* p. 500.

Hypophosphite of potash is a white opaque, slightly deliquescent salt, very soluble both in water and alcohol.

Hypophosphite of Ammonia.

Take of hypophosphite of lime . 6 oz.
„ sesquicarbonate of ammonia 7½ „
„ water . . . . a sufficient quantity.

Dissolve the lime salt in four pints of water, and sesquicarbonate of ammonia in two pints; mix the solutions, throw on a filter, and wash the residue. The filtrate is then evaporated to dryness; and if the salt be required in crystals it must be dissolved in alcohol, filtered, evaporated, and set aside in a warm place to crystallise.

Hypophosphite of ammonia deliquesces in the air, and is very soluble both in alcohol and water. When carefully heated it parts with its ammonia, and hypophosphorous acid is left behind.

(*To be continued.*)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture V. *On Volcanos.*

(*Concluded from page 166.*)

There is one other point to which I have not yet alluded, and that is the pouring out of very large quantities of hot water. The Geysers of Iceland are remarkable phenomena of this kind. They consist of the bursting out at irregular intervals of a column of water nine or ten feet in diameter, rising into the air some hundreds of feet and then suddenly terminating. The spot from which the water rises is like a basin with a pipe run into the earth. The pipe always has hot water which bubbles and rises to the surface and remains there, but at last is thrown up into the air and then drops down again rapidly and is lost. The cause of it is probably connected with the presence of a very large quantity of water in an exceedingly heated state, the pressure of steam producing the result.

There is one more point—the general uniformity of volcanic matter erupted in different parts of the world. This is of considerable importance and is not to be lost sight of. All volcanos erupt very nearly, if not precisely, the same material. Sometimes the dust consists partly of silicious envelopes of minute animals, such as those found at the bottom of the Pacific. (Those at the bottom of the Atlantic are chiefly calcareous, those of the Pacific chiefly silicious). In all parts of the world the ash or dust is the same; the gases are the same, and the minerals poured forth are in the same state.

Such being the phenomena we have next to state how they are to be explained. To understand this it will be necessary to consider the causes of several groups of phenomena. First, the outburst, the original fracture of the earth. Next, the nature of the materials themselves, and the form in which they occur. And, lastly, the form of the crater. How can we understand that such an exhibition can take place as an occasional opening of the crust of the earth? There are three ways in which it may be assumed as possible; one dependent altogether on chemical decomposition. It has been supposed that there has been at various places at a great depth a very large quantity of materials which only require the presence of some other minerals to produce sudden and violent explosion. The metals from which are derived common limestone and salt (calcium and sodium) when suddenly exposed to the action of water decompose the water, absorbing the oxygen with wonderful rapidity and setting free the hydrogen. This is a tendency to explosion which has been considered sufficient to cause the effect. Then another reason. We find the surface of the water at a certain depth at a constant temperature, and as we go deeper the temperature steadily increases; at a certain depth therefore we shall find that it is hot enough to form steam, but is retained as water by pressure. This supposes that the earth is intensely hot at all parts of the interior, or, even that it is still molten, only the external crust being hardened and cool. It also supposes that there is a constant change going on by the contraction of the surface, or by its expansion when a portion of the surface is exposed to the action of heat; in either of these cases new portions of matter may come under the influence of heat. Under these circumstances if only water can come in from above it is suddenly converted into steam and originates the volcanos. Then there is a third view, which does not require us to assume that the interior of the earth is fluid owing to enormously high temperature. Admitting that there is an increase of temperature on going down we may suppose that in certain places in volcanic districts there are cavities communicating with each other. In these there are certain modified conditions of extreme temperature, confined, however, to those particular localities. These are the three ways of accounting for the cause of the outburst.

We must next consider what is the cause of the nature and condition of the materials erupted; because these are not the common materials we meet with on the face of the earth. We find, for example, where no volcano exists, limestone, sandstone, or clay. In other districts mica—slate, or granite. But in those places where there has been a communication with the interior the change is very great. Instead of having limestone or calcareous rock and sandstone, we always find that particular combination of minerals which we know under the name of basalt, lava, pumice, or volcanic ashes, which are modifications of one thing. It is because these have all undergone a considerable amount of atomic change, and a considerable amount of decomposition, that these rocks may be assumed to be due to similar causes acting far beneath the surface. The various materials are after all combinations of the same elements as those we find commonly at the surface. They are present in different proportions, but the combinations have also been formed either at the surface of the earth or beneath the earth, in other words, either without pressure, or at enormous pressure, and both with and without water at high temperature. We find erupted from volcanos steam as well as gas, and this is not very extraordinary. The first thing given off when the pressure is relieved would undoubtedly be the steam. The next thing, or with the steam, would be those gaseous products which are formed during changes that go on in the great laboratory of the earth, which we know is constantly elaborating chemical products organic and inorganic. Sulphurous and carbonic acid gases are the two most common gases that are erupted. That we should get gases as well as stones and lava I have already explained, because the ashes are after all nothing more than the fine material produced by the breaking up of the bubbles that are formed by the gas when the rock passes in a boiling state.

We must also consider why it is that these materials are presented to us in the form of a cone terminating with a crater. There are two very distinct theoretical views with regard to this, one taken some years ago by Von Buch, and the other still more ancient. Von Buch advocated what is called the elevation-crater theory. It is supposed, according to this theory, that a large quantity of matter erupted before the volcano rose has suddenly been thrown up during the beginning of a volcanic outburst, and that all the rock immediately adjacent has been thrown up with it so as to form a shelving coat of lava on each side, and in this way it has been supposed that the conical form of volcanos has been produced. Now this is to a certain extent a gratuitous presumption, for there is no proof that any such illustration has gone on in any particular district. The particular case of one in America, generally quoted, does not give us the evidence. Practically the question resolves itself into this. Is it absolutely necessary to assume that lava must have been

originally poured out on a horizontal surface, or can it be that melted rock is capable of lying on a very inclined surface without actually falling over? Now this is a question of fact, and the opinion of English geologists is that it has been completely answered by the observations of Sir Charles Lyell on Etna, and also by observations of other volcanos recently examined. In all these cases it has been proved that the lava is capable of being retained at an angle of 35°. The other opinion is that in each particular case of volcano the great mass of the mountain has been produced by the matter erupted from it. It might have been that the quantities are so large as to render it difficult to account for them. Volcanic mountains are grouped in volcanic districts. It is possible, no doubt, that volcanos may occur in ground lately elevated, but it is true that the lava seen on the sides of volcanos may have accumulated on the spot and frequently does so. On this assumption a large accumulation is perhaps originally formed, and being thrown into the air has fallen back to form the conical hill, while the inside was being blown out. After one eruption others would soon succeed. Upon the surface of this cone, or forming a part it, beds of lava may pour, and when the operation has gone on a considerable time and a large quantity of matter has been erupted, and the whole of the inside, as it were, blown out, then the sides of the cone might fall in and cause a reversion of the dip.

In the Island of Bourbon is a volcano with a number of dykes ranging from the centre, and they are filled up from time to time. You will easily see that there would be a certain amount of expansion produced and crevices formed by this process. The lava poured out would naturally run into those crevices and make them gape wider and thus form dykes, the outside being in fact made up entirely of a number of those dykes and intervening matters.

It would be well were it possible to determine the relation that exists in nature between volcanic eruption and the great mountain chains of the earth. We should then understand better than we can now how far these are results of slow upheaval independent of violent disturbing force, and whether they may not indicate a state exceedingly different from that existing beneath volcanos. But it is only after a careful investigation of a very different nature that this question can be discussed, and we must therefore postpone all consideration of it for the present. I have endeavoured to show you to-day that volcanos indicate the presence of forces of a very powerful kind, acting in belts or zones in various parts of the earth, but by no means everywhere; that these zones each contain some special localities where communication is occasionally open to the interior of the earth; that the communication thus opened is generally not only of the same nature, but brings to the surface similar natural products, and that in some cases the very large quantity of these products erupted must produce some effect on the interior since it builds up mountain masses at the surface.

Various theories have been put forward to explain the phenomena, and of these one class assumes and another considers unnecessary any exceedingly high uniform temperature within the surface. Each of these has distinguished supporters and deserves careful consideration. It may seem to you a matter of comparatively small importance whether one theory or another is adopted with reference to this singular class of natural phenomena. But it is not altogether so. A great question—one that has been and will long continue to be debated among geologists is at the bottom of the discussion. It is a part of the battle between those who advocate the view that this world has been formed and is sustained by laws acting with great uniformity throughout all time, and those who believe in great and sudden and (geologically speaking) frequent convulsions and interruptions of the regular current of mundane affairs. It affects the question as to whether earthquakes and volcanic eruptions and other paroxysmal and convulsive occurrences are normal and necessary results of a system of perfect order, or abnormal interruptions of such a state of order.

I would not presume to discuss this question on other grounds than those of experiment and observation, but assuming, as I think we may, that the balance of evidence is in favour of the possibility of all known volcanic appearances being produced by the repetition of ordinary volcanic action, I would remind you that in such a case we are bound to admit the hypothesis most consistent with reason and experience. Since, therefore, earthquakes occur with unceasing regularity and very frequently; since earthquakes and volcanos have very intimate relation one with the other, and we know that volcanos are only temporary phenomena shifting their place from time to time, active to-day, extinct to-morrow, it would seem probable that convulsive movements in the earth are part of a still larger series of movements governed by regular laws, and not unconnected with the existence of those cyclical periods which bring our earth into harmony with one immediate satellite, with the centre of our system, and even with the neighbouring planets.

It is the tendency of investigations such as those we have been concerned in to-day to induce us to consider in their mutual dependency portions of created matter which most of us are in the habit of regarding as altogether independent. But I do not hesitate to tell you that there is no such thing as independent existence. We, the inhabitants of the earth, are no less mutually dependent on each other and on all created beings than is our habitation, the earth, on other habitations in space. Our earth and moon together form parts of a larger system, consisting of a number, we know not how many, solid bodies revolving round a central sun. That sun with his planets and their satellites are parts of a larger system which itself perhaps is only subordinate to some other. We may not be connected with all these by the great law of gravitation, which may itself be only subordinate, but we are connected with them, we are influenced by them, and we have mutual relations with masses of matter so distant that we cannot even estimate their distance, and it is just by these unknown relations, these ties invisible, intangible, yet binding us all firmly together that the earthquake and the volcano, the storm within the earth as well as the auroral storm in the upper, or the thunder storm in the lower regions of the atmosphere are all governed, and their times and seasons of occurrence unalterably fixed. There are no interruptions of the order. Order is, so far as we can tell, "Heaven's first law," a law obeyed in the outburst of molten rock from the bowels of the earth, or the rending asunder of its solid crust, as well as in the bursting of the leaves and the blossoms in the spring, or the ripening of the fruit in autumn.

NOTICES OF BOOKS, PATENTS, &c.

Handbuch der Chemischen Manipulationen. Von C. Greville Williams. *Aus dem Englischen übersetzt von* A. von Hammerl. München. 1860.

In a former number of the Chemical News (vol. i. p. 32), we directed the reader's attention to Mr. Williams's exhaustive treatise on *Chemical Manipulation*, characterising it as the only work on the subject which at all adequately describes the various operations and processes of chemistry, a science which owes so much to manual dexterity and felicitous invention in the construction and employment of apparatus. Our high opinion of the work has been since corroborated, not only by the wide spread and great esteem which this book, so necessary to every chemist, has acquired in England, but also, now more especially, by the appearance of a German translation. This publication (unsanctioned as far as we can gather) of the volume in a foreign dress, cannot however be otherwise than gratifying to the author, since the work has been reproduced without addition or alteration being thought requisite. It cannot, however, be denied, that the German edition would have been more valuable, had some of the original woodcuts been reproduced with greater fidelity, although in general typographical ex-

cellence it scarcely falls short of the English work. With some difficulty we succeeded in finding one or two omissions in the original work, but it was a mistake on the part of the German translator not to supply these, as well as a few other deficiencies which the progress of the science has since caused. As we expressed on a former occasion our opinion of the English original, we think that the following preface by Dr. Wittstein, which will be found in the translation, may prove acceptable. We cannot, however, refrain from saying that Dr. Wittstein's estimate of Faraday's treatise on Chemical Manipulation, a most excellent work at the time of its publication, and valuable in many respects even now, is decidedly erroneous.

The Preface is as follows: —

"In the year 1827, the chemist Faraday, subsequently celebrated as a Natural Philosopher, published a work in London under the title of *Chemical Manipulation*. This volume, however, together with much that was excellent and useful, contained a good deal of superfluous matter, while on a variety of subjects it omitted the information we were entitled to expect from such a work. It therefore appears to have found no particular favour, at least among us, and may perhaps be wholly unknown to the rising generation.

"On the other hand the case is quite different with a work by Williams, which appeared in London two years ago, likewise under the above-named title. The author, already well known as one of the most eminent of English chemists, came forward in that work in the light of an expert manipulator also, who possesses a singular dexterity in constructing with his own hands most of the apparatus necessary for his own use. The book contains more than the title promises, but this is no blemish, especially as the materials of this extension are very well selected and very instructive. But nothing we look for is sought in vain, a fact greatly to the author's credit. The numerous and most valuable processes here described, and accompanied by admirable illustrations, are not to be found collected in any other book; they can only have been the result of long and devoted toil in the laboratory. The Author too has done the more service in disclosing his various methods and operations, inasmuch as chemical literature could not before have furnished similar information. The descriptions throughout are complete, perspicuous and reliable, and proclaim the author to be a perfect master of his subject.

"Thus it was a happy thought to render this practical work more accessible to the German chemical public by means of a translation. The translator had in some degree a not altogether easy task, for in the numerous descriptions of apparatus many technical expressions occur, concerning the correct German equivalent of which the dictionaries do not always give the requisite explanation. But he has, as I have convinced myself by a close comparison with the original, happily overcome this difficulty in every instance: he has also reproduced in a remarkable degree the style and tone of the text as truthfully and as distinctly as we could possibly desire. In the printing, moreover, no expense has been spared, in order to bring out the German edition as a worthy and exact counterpart of the English. It gives me, therefore, particular pleasure to be able to preface the work with these few words of compliment and praise."

CORRESPONDENCE.

Village Grocer-Druggists.

To the Editor of the Chemical News.

Sir,—I shall be glad if you will allow me to say a few words in favour of village hucksters. In my opinion this is the most useful class of tradesmen in existence, and I am certain the shops would lose much of their value if they did not contain some simple medicines. How could a druggist, even were his business as miscellaneous as some in town, get a living among a scattered population of 400 or 500 people? And if a pharmaceutical chemist cannot keep a respectable shop, is that a reason why Hodge should have to walk five or six miles for a pennyworth of laudanum when he has a toothache, or for a little tincture of rhubarb when his bowels are out of order? I stand up for hucksters. I know their shops well, and I never remember to have heard of a mistake which caused anybody's death being made in one. They keep laudanum in a bottle which is honestly labelled laudanum, and they do what Mr. Proctor recommends all druggists to do—they read the label—and consequently never sell laudanum for anything else. They keep Epsom salts too in a tin canister, on which is written Epsom Salts, and they don't generally keep arsenic and oxalic acid. When anybody in our village wants to poison himself or anybody else, he goes to the large druggists in the next town, and the only candidate we have had for the gallows within my recollection got the arsenic at a "Pharmaceutical Chemist's."

It would be a very fine thing no doubt, for druggists and public too if there were no shops but such as Messrs. Savory's and Proctor's; but unhappily there are lots of people who will be poor, and some who will not live in a large town. Of course they deserve to suffer for this; but there are people who dont think so, and they look on the village shop which combines nearly all trades, as a great convenience—not the least benefit being the selling of medicines.—I am, &c.

W. P.

The Sale of Poisons.

To the Editor of the Chemical News.

Sir,—In the interesting correspondence concerning the prevention of accidental poisoning, it seems to be forgotten that if a further extension of the "Sale of Poisons Bill" took place *all poisons* (defined, as one of your correspondents has observed, by the *maximum dose* used in medicine being under a certain quantity) would be forbidden to be sold under a heavy penalty to any under age; thus meeting the danger of children being sold poisons, and the chemists would be warned and given power *not* to sell any poisons under suspicious circumstances or frivolous pretences, as strychnine for experiments as a pretext. If such is in the power of the legislature (and it is) why should not memorials and petitions be forwarded to Parliament from influential persons and others, praying some such regulations as the above to be enacted. Moreover, while not in the least least slighting the proposals for reminding the chemist himself and the customers of the drug being noxious, as by the employment of Messrs. Savory and Moore's excellent poison bottles, which ought to be used in every establishment as well as the *bright orange label* now used for poisons in France, still care should be forced on the chemist by making him highly responsible, punishable with heavy fine and imprisonment in cases of mere carelessness, and tried for *manslaughter* if any death resulted from his selling poison in mistake, or in circumstances of grave suspicion. Moreover, ought not every case of careless sale of poisons reported to be taken into consideration in renewing the chemist's licence? Hoping these few ideas may aid some of your readers in their endeavours in such a laudable cause, I am, &c.

Alpha.

Appearance as a Standard of Chemical and Physical Measurement.

To the Editor of the Chemical News.

Sir,—Any person who will take the trouble to consider the various conditions which substances assume when submitted to any species of chemical analysis, cannot, I think, but allow that mere appearance is a very unsatisfactory guide with which to pursue either quantitative or qualitative research. And yet it is sometimes the only implement which is, and perhaps can be, made use of. When under any circumstances it is found that the vapour produced from any liquid is less

than would have been expected from the amount of liquid evaporated, I see not how from the appearance only it can be positively affirmed that the vapour has become denser, because this supposes us to know what quantity of liquid must be evaporated to produce vapour of a certain density; which is not the case, inasmuch as the density of any vapour produced in a vacuum cannot be ascertained, and thus a comparison cannot be instituted; and besides this it is easy to understand that an increase in the volume of any vapour can only very roughly be determined by inspection, but this it is true can be subjected to verification by weight. The density of vapour cannot under any conditions be determined by appearance, and this because, whether it is or is not in a vacuum, it is impossible to say when the particles are in contact and any space is filled, and when the vapour commences to grow denser. I do not mean to affirm that the increase in the density of any vapour, which is apparently nothing more than the closer contact of its parts, or more properly the contact of a greater number of its particles, cannot be discerned by appearance where this is considerable, but as regards its commencement when a certain space has been filled with vaporous particles, and the gradual increase of this, I do not perceive that visual appearance is of any value.

Similar difficulties present themselves in physical investigations. Our instruments enable us to discover the comparative intensities of light, heat, and other phenomena. And this is all. By appearance we are unable to decide what amount of light is double of any particular amount, and our sense of feeling is alike impotent with respect to heat. And here, and in similar cases, our philosophical instruments are useless. The photometer may after human calculation show that a certain amount of light is double that of some other experienced amount, and according to the thermometer it may by some be judged that when it stands at 60° the heat is double what it is when it is at 30°; but when it is remembered that these divisions are artificial it will be seen that the conclusions are equally so, and thus that the chance of their correctness is amazingly small. It is well worthy of observation that the barometer, being independent of human feeling, is necessarily an absolute instrument.—I am, &c.

J. A. Davies.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Researches on the Platinum Metals.—Dr. Wolcott Gibbs describes[1] some complex new bases containing osmium and ammonia. "When, for instance," he says, "osmite of potash is added to a solution of the chloride of pallad-diamine, $2NH_3.PdCl$, a yellowish brown solution is formed, which on addition of chlorhydric acid gives a beautiful fellow crystalline precipitate, insoluble in cold water, and containing palladium, osmium, and the elements of ammonia.

"When osmite of potash is added to a solution of chloride or sulphate of luteo-cobalt $6NH_3Co_2Cl_3$ or $6NH_3.Co_2O_3.3SO_3$, a buff-yellow precipitate is thrown down, which on addition of HCl gives a wine-yellow solution. This solution after a short time deposits beautiful crystals of the chloride of a new base containing osmium, cobalt, and the elements of ammonia. The chloride gives well crystallised salts with the chlorides of platinum, gold and mercury. Its solution is decomposed by gentle heating, osmic acid being evolved, while a black powder is thrown down.

"When ammonia is added to a solution of osmite of potash the red colour of the latter passes immediately to a wine-yellow. Frémy supposes that an osmiamid is formed here, having the formula $O_3O_2.H_2N$. I find that the product is a new osmium base, the chloride of which is formed at once by neutralising the yellow solution with HCl. This chloride has probably the formula

$$\left.\begin{matrix}H_3\\Os\end{matrix}\right\}NCl, \text{ though it may be } \left.\begin{matrix}H_3\\OsO_2\end{matrix}\right\}NCl."$$

Influence of Bismuth on the quality of Copper. M. Levol, chemist in the French Mint, has found that an addition of a thousandth part of bismuth to pure copper almost entirely destroys its ductility. He discovered this in analysing some specimens of Australian copper, which although nearly pure, containing 99·48 of copper, were yet of very inferior quality, owing to the presence of a very small amount of bismuth.

Chromate of the Oxide of Chromium.—M. Vogel, jun. says that this compound is obtained in the form of a brown precipitate when bichromate of potash is treated with ammonia and the mixture is exposed to the action of light. Alcohol also reduces the bichromate in the light, and gives the same precipitate. When treated with hydrochloric acid chlorine is disengaged; when calcined it is changed into oxide of chromium.

II. ORGANIC CHEMISTRY.

Constitution of Sugar.—M. Gelis has already shown[2] that crystallisable sugar when fused breaks up, and is transformed partly into a right handed glucose, and partly into a new body to which he has attributed the formula $C_{12}H_{10}O_{10}$. The latter body does not ferment directly, but by the action of dilute acids it is changed into an uncrystallisable glucose, the rotatory power of which to the left is superior to that of the "inverted" sugar. M. Gelis therefore[3] agrees with M. Dubrunfaut in considering crystallisable sugar as a compound sugar; and he thinks that the new body mentioned above is formed at the expense of the "left element." In continuing his experiments he has noticed that the products were modified when the sugar was kept for some time in a state of fusion. This result led him to try whether the simple sugars or glucose would not by simple dehydration yield bodies isomeric with the formula $C_{12}H_{10}O_{10}$. Accordingly he experimented with glucose prepared with starch and sulphuric acid, or extracted from honey, and with some obtained with inuline, and from each obtained a corresponding new body. Ordinary glucose heated to 100° or 110° parts with two equivalents of water, and does not become coloured. At 170° two other equivalents of water are driven off, and a mass is obtained more or less coloured. This mass contains various matters. The greater part is a colourless body which does not ferment directly, but becomes fermentable on being changed into glucose by the action of dilute acid. It is not easy to isolate this new body; but the conditions under which it is produced and the results of the author's analyses show that its composition must be represented by the formula $C_{12}H_{10}O_{10}$. It has then the composition of dextrine, and experiments prove that it is also a *dextrogyre* (a word which, as well as its opposite *levogyre*, we may as well adopt); but the number which represents its rotatory power is rather lower than that of the glucose from which is is formed. Analogous results are obtained when the glucose of inuline is treated in the same way. The glucose of milk sugar also yields a body of the same order.

M. Gelis has already given the name of *saccharide* to the new body obtained from sugar[4], but as the termination *ide* is already appropriated in the case of glucosides, he proposes the name *glucosane* for the body obtained from glucose.

MISCELLANEOUS.

The Adulteration of Food and Drink Bill in the City.— The Commissioners of Sewers for the City of London held their weekly court on Tuesday last at the Sewers Office, Guildhall. Mr. Deputy Christie presided.

[1] *Amer. Journ. of Science and Art*, vol. xxix. p. 407.

[2] *Comptes-Rendus*, t. xlviii. p. 1061.

[3] *Ibid.* t. li. p. 331.

[4] Chem. News, vol. i. p. 154.

The minutes of the last court were read and confirmed.

Deputy Lott said he presumed, by the reading of the minutes of the proceedings of the last court that an Act of Parliament that had just been passed by the Legislature had been referred to a committee for consideration. The Act to which he referred was the Adulteration of Food Act, and the provisions of that Act appeared to him to be of a very important character, because if it was carried out the effect would be to enable the poor to obtain genuine food of every description—beer, milk, bread, &c. The Act, however, was only permissive, and he was anxious to know whether the terms under which the consideration of the subject was referred to the committee were such as would enable them to recommend that the Act should be adopted in the City of London, if they thought proper to do so. It appeared to him that this Act of Parliament was a most beneficial one, and he hoped to see it carried into effect.

The Chairman said that by the terms of the reference the committee were invested with full power to act as they might think proper in the matter.

Caution to Bribers.—A ludicrous incident occurred in one of our London chemical manufactories, a few days ago, to which we give publicity with the double view of cautioning manufacturers, and also the would-be seducers of workmen.

A foreign gentleman (?) it seems, had offered one of the workmen employed in the laboratory the magnificent sum of five pounds to be let into an important and valuable secret. Another five pounds were promised if the man could by any possibility admit the gentleman after dark to inspect the works. The man honestly told his employers of the offer that had been made to him, and after a little thought it was decided that our friend should be admitted.

So on an appointed evening last week, after working hours, the gas was turned down at the main, and with a great appearance of secresy he was duly let in. He had proceeded some distance, and was busy examining the contents of a few pans, when the gas was suddenly turned full on, and all the workmen employed on the premises made their appearance, provided with a variety of offensive but harmless chemicals, with which they thickly bespattered the unfortunate wight. After some rather rough usage he was turned into the street to be handed over to the police, but in such a filthy condition that the men of law declined to lay hands on him, and he was allowed to depart a better and a wiser man, it is to be hoped, but still ignorant of the secret.

Tempering Steel.—Each variety of steel requires a different degree of heat, preparatory to plunging it in cold water, for the purpose of hardening. As it is very difficult to tell the degree of heat to which a piece of steel has been raised in a fire, the process called tempering provides for the difficulty. The steel is first heated in a clear fire to the highest temperature it will bear without being permanently injured, and is then cooled so as to impart to it the greatest hardness. It is then ground or polished so as to show a bright surface, and gently reheated until the bright surface shows a certain colour. The colours produced by the increasing heat on the bright surface are, in succession, yellow, brown, purple, light blue, dark blue, and black. These shades are used for the following purposes:—Yellow for lancets, razors, pen-knives, cold chisels and miners' tools; brown for scissors, chisels, axes, carpenters' tools, and pocket-knives; purple for table-knives, saws, swords, gun locks, drill bits and bore bits for iron and metals; and blue for springs, small swords, &c. Articles which are to be softer are made still darker; but when the black shade is reached the steel is annealed and soft. These colours are the result of oxidation. The increasing thickness of the film of oxid which accumulates on the bright surface of the steel is less and less apparent as the heat increases. Steel receives by sudden cooling that extreme degree of hardness combined with tenacity which places it so incalculably beyond every other material for the manufacture of cutting tools; especially as it likewise admits of a regular gradation from extreme hardness to its softest state when subsequently reheated or tempered. Steel therefore assumes a place in the economy of manufactures unapproachable by any other material; consequently we may safely say that without it it would be impossible to produce nearly all our finished works in metal and other hard substances.

In the process of hardening steel, water is by no means essential, as the sole object is to extract its heat rapidly; and the following are examples, commencing with the condition of extreme hardness, and ending with the reverse condition.

A thin heated blade placed between the cold hammer and anvil, or other good conductors of heat, becomes perfectly hard. A nearly similar variety of conditions might be referred to, as existing in cast iron in its ordinary state, for some cast iron may be rendered externally as hard as steel, such as chilled iron castings, which are cast in iron moulds.

Gold in Georgia.—From the Field's Gold Vein in the bed of the Chestatee river, Georgia, 10,000 dollars worth of gold was taken out of a pit ten feet deep, and one bushel of the rock yielded 3000 pennyweights. Some very large nuggets of gold from the mines of the Nacoochee Hydraulic Company, weighing respectively 387, 115, and 59 pennyweights, compare favourably with the nuggets of California and Australia in size and richness. The 387 pennyweight mass is the largest yet found in Georgia. These and a much larger weight of smaller masses were washed out by the hydraulic process from the top of a ridge above the river, they being in what the miners call a hill deposit.

Royal Veterinary College.—Mr. R. V. Tuson, Lecturer on Chemistry at Charing Cross Hospital, has been appointed to the Professorship of Chemistry at the Royal Veterinary College, vacated by Mr. Morton.

We sincerely congratulate both the Royal Veterinary College and the new Professor on the appointment. A gentleman more suitable for the post could scarcely have been found.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A Constant Subscriber.—We are not aware that the colouring matter of shells has ever been separated and examined. A short account of the chemistry of shells will be found in Brande's *Manual*.

S. P.—Griffin, Bunhill Row, London.

A Subscriber.—An answer next week.

C. E.—Will be answered next week. We shall be happy to receive anything he may send.

Received—*Dr. Letheby—J. A. Davies—B. S. A.* Mr. Proctor's letter shall appear next week.

Book received—Ure's *Dictionary of Arts, Manufactures, and Mines*. Edited by R. Hunt, F.R.S.

Vol. I. of the Chemical News, containing a copious index, is now ready, price 8s. 6d. handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. if sent to our office, or, if accompanied by a cloth case, for 6d.

*** All *Editorial Communications* are to be addressed to Mr. Crookes and *Advertisements* and *Business* communications to the Publishers C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street London. E. C.

CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnandon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Bouttlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, Baillière, 219 Regent Street, London.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Non-existence of Combinations of Hydrogen with Iron and Zinc, by Dr. CHARLES A. CAMERON, *M.R.I.A. F.C.S. Professor of Chemistry, &c.*

THE terms "zincuretted hydrogen" and "ferruretted hydrogen," occur in several standard works of recent date; such, for instances, as Booth's *Encyclopedia of Chemistry*, 1852, and Hunt's *Poetry of Science*, 1854. These terms indicate compounds which are supposed to be formed during the dissolution of iron and zinc in hydrochloric or sulphuric acid. The production of zincuretted hydrogen, in this way, at least, was doubted by Berzelius[1], and proved not to be the case by Fresenius, whose experiments are detailed in Gmelin's *Chemistry*, a book which was published before either of those referred to above. I also have made this the subject of experiment, not only for the purpose of proving whether or not compounds of zinc and iron with hydrogen are formed during the dissolution of these metals in dilute sulphuric acid; but also to determine whether or not such bodies can be formed at all. My experiments were conducted in the manner described as follows: —

Iron turnings were dissolved in cold dilute sulphuric acid, and the hydrogen gas which was evolved was conducted, after washing in distilled water, into a receiver containing nitro-hydrochloric acid. The evolution of the gas was continued for the period of two hours, and at the conclusion of the operations the acid contents of the receiver were neutralised with caustic ammonia, the resultant saline solution concentrated, acidulated with a little pure hydrochloric acid, and tested for iron in the usual way; but without the slightest trace of that metal being detected therein.

Now, as arseniuretted, and antimoniuretted hydrogen, are readily decomposed by nitro-hydrochloric acid, it is only reasonable to infer that ferruretted hydrogen, if such a compound had been formed during the operation I have described, would have been similarly affected by this agent.

In the next experiment some oxide of tin, free from the slightest trace of iron, was introduced into a long, hard glass tube, and the latter heated to redness. Hydrogen gas, prepared as already described, was passed through a desiccating apparatus, and then conducted into the heated tube. The operation was continued until the greater portion of the oxide of tin was decomposed. The surface of the oxide of tin was so great, and the gas so slowly evolved, that none of the latter escaped from the exit end of the tube; nothing but steam passed off. The reduced metal and the undecomposed oxide were next removed from the tube, and, having been dissolved, were found, on the application of appropriate tests, to be perfectly free from iron.

[1] On prétend que le zinc peut se dissoudre dans le gaz hydrogène: mais il est probable que ce qu'on a pris pour du zinc était de l'arsenic; car, même le zinc distillé peut contenir une petite quantité de ce dernier métal.—*Traité de Chimie, par Berzelius, Bruxelles*, 1839.

Experiments, similar to those above described, were made with pure zinc, and were attended with like results.

I do not pretend to affirm that I have proved the utter impossibility of producing gaseous combinations of hydrogen with iron and zinc; but allowing that they may exist, that they are never formed during the dissolution of the metals in acids, may be reasonably inferred from the results of the experiments just detailed. Indeed, I entertain doubts as to the possibility of forming such compounds — composed as they would be respectively of two highly electro-positive elements — by any process. All my attempts to combine hydrogen with iron and with zinc — and they have been numerous — resulted in failures. The combinations cannot be brought about by the action of steam, or of sulphuretted hydrogen on the alloy of sodium and iron, and that of sodium and zinc; yet here the hydrogen and the metal are mutually presented in the nascent state, a condition the most favourable for combination. We know how readily the metals arsenic and antimony combine with hydrogen, when the latter alone is presented in the nascent state.

Notes on some of the Chemical Reactions of Corrosive Sublimate, by T. G. WORMLEY, *M.D.*

THE solutions of corrosive sublimate used in the following experiments were made by dissolving the pure salt in water. A small drop of a saturated solution of the reagent was applied by means of a pipette to a *grain measure* of the corrosive sublimate solution contained in a watch glass, or upon a glass slide.

The amount of corrosive sublimate operated upon will frequently be stated in the form of a fraction, it always being understood to imply the fractional part of a grain of the salt dissolved in one grain of water.

I. Potash.—1. $\frac{1}{100}$th, grain of corrosive sublimate gives, with a small drop of a strong solution of potash, an immediate bright yellow amorphous precipitate, insoluble in excess. The precipitate is rather copious.

2. $\frac{1}{200}$th, gives no immediate precipitate; after standing some little time there is a slight cloudiness.

II. Ammonia.—1. $\frac{1}{100}$th, gives a good dirty white flocculent precipitate, insoluble in excess of the reagent. If the mercury solution be exposed to the vapour of ammonia it gives the same reaction.

2. $\frac{1}{1000}$th, a good bluish white amorphous precipitate.

3. $\frac{1}{2000}$th, gives a pretty good precipitate.

4. $\frac{1}{5000}$th, a quite satisfactory reaction, by either ammonia or the vapour.

5. $\frac{1}{10000}$th, gives a perceptible cloudiness.

III. Carbonate of Potash.—1. $\frac{1}{100}$th, if a small quantity of the reagent is added to the mercury solution it gives a yellowish, or reddish yellow, precipitate; when an excess of reagent is used, the precipitate is of a brick red colour.

2. $\frac{1}{200}$th, only a slight cloudiness.

Iodide of Potassium.—1. $\frac{1}{100}$th, gives an immediate bright scarlet amorphous precipitate, which is

readily soluble in excess of the reagent, or the mercury solution.

2. $\frac{1}{500}$th, a yellow-red precipitate.

3. $\frac{1}{1000}$th, gives a yellowish precipitate.

4. $\frac{1}{2000}$th, by using a very small quantity of reagent a pretty good and permanent yellow precipitate.

5. $\frac{1}{5000}$th, this quantity gave no satisfactory indication in a number of cases in which the least possible quantity of reagent was used.

The least visible quantity of corrosive sublimate in the solid state introduced into a solution of iodide of potassium becomes immediately yellow, changing to scarlet. When a solution of corrosive sublimate is evaporated to dryness, and the residue touched with a small drop of iodide of potassium solution:—

1. $\frac{1}{100}$th grain, the deposit assumes a fine scarlet colour.

2. $\frac{1}{1000}$th grain, much the same as 1.

3. $\frac{1}{10000}$th, the deposit assumes a distinct yellow colour, and soon dissolves.

V. Ferrocyanide of Potassium.—1. $\frac{1}{100}$th, a copious dirty white amorphous precipitate, soluble in excess.

2. $\frac{1}{1000}$th, a pretty good precipitate, readily soluble in excess.

3. $\frac{1}{2000}$th, difficult to obtain a slight trace.

VI. Ferricyanide of Potassium.—1. $\frac{1}{100}$th, a good greenish yellow amorphous precipitate, insoluble in excess.

2. $\frac{1}{1000}$th, much like 1.

3. $\frac{1}{2000}$th, quite a good greenish precipitate.

4. $\frac{1}{5000}$th, a just perceptible cloudiness.

VII. Chromate of Potash.—1. $\frac{1}{100}$th, immediately a rather good greenish yellow flocculent precipitate.

2. $\frac{1}{500}$th, a distinct cloudiness.

Bichromate of potash gives no precipitate with $\frac{1}{100}$th solution of corrosive sublimate.

VIII. Nitrate of Silver.—This test is for the purpose of detecting the chlorine of the corrosive sublimate.

1. $\frac{1}{100}$th, grain of corrosive sublimate gives a copious curdy white precipitate, which partly dissolves in excess of ammonia, and is soon replaced by a rather copious partly granular precipitate.

2. $\frac{1}{1000}$th, a bluish white, soon changing to a white precipitate, soluble, with difficulty, in ammonia, but soon replaced by a dirty white partly granular precipitate.

3. $\frac{1}{10000}$th, a rather abundant bluish white precipitate, readily soluble in ammonia, and soon replaced as in 2.

4. $\frac{1}{20000}$th, a quite good precipitate.

5. $\frac{1}{100000}$th, a very satisfactory reaction.

6. $\frac{1}{200000}$th, a very perceptible opalescence, which, after a little time, becomes very distinct.

7. $\frac{1}{1000000}$th, gives a just perceptible cloudiness.

The last-mentioned quantity of corrosive sublimate would contain only $\frac{1}{3200000}$th of a grain of chlorine. This result agrees closely with that obtained by the reagent with chlorine when in combination with ammonium, as given in Gmelin's *Handbook*, vol. ii. p. 355, in which a solution of sal-ammoniac containing one part of chlorine in 3,200,000 parts of water gave with nitrate of silver "a barely perceptible cloud."

IX. Chloride of Tin.—1. $\frac{1}{100}$th, gives a light grey, thin dark precipitate, which is rather copious.

2. $\frac{1}{1000}$th, much like 1.

3. $\frac{1}{5000}$th, a quite good deposit.

4. $\frac{1}{10000}$th, a pretty fair indication.

5. $\frac{1}{20000}$th, gives a distinct reaction.

X. Hydrosulphuric Acid.—The solutions of corrosive sublimate were acidified with hydrochloric acid, and a stream of washed sulphuretted hydrogen passed into ten grains of the mercury solution.

1. $\frac{1}{100}$th, when the solution holds this proportion of its weight of corrosive sublimate, it gives an immediate brown, which soon changes to a dark brown, and ultimately to a copious black precipitate.

2. $\frac{1}{1000}$th, a yellow brown, brown, then rather copious black precipitate.

3. $\frac{1}{10000}$th, the solution immediately becomes brownish, then small brownish flakes, and, after a little time, a good brownish precipitate.

4. $\frac{1}{20000}$th, the solution immediately becomes yellowish, and, in a few minutes, very small brownish flakes appear, which after standing for some time subside, and form a distinct deposit.

5. $\frac{1}{50000}$th, very soon the solution becomes turbid, and after standing some time a deposit is just perceptible; if viewed with a lens it is quite evident.

6. $\frac{1}{100000}$th, no indication after several hours.

(To be continued.)

On some Supposed Numerical Relations between the Equivalents of Simple Bodies.

In a recent number of the Chemical News (p. 134) are given some extracts from a paper by Mr. C. Lea, in which it is endeavoured to be shown that the equivalents of certain elementary bodies have the numerical relations 3 : 7 or 4 : 7; and the writer appears to consider that the existence, if admitted, of such ratios between the equivalents of certain bodies, taken two and two, indicates the existence of occult relations between them that ought to induce us to group such substances together, whatever may be their known chemical or physical characters. It seems to us that the existence of these ratios, either exact or approximate, depends on no magic attaching to these numbers, but arises from the fact that in many isomorphous groups, possibly in all, the equivalent of any one member of the group is an exact, or very approximate, multiple or submultiple of the equivalent of any other member of the same group; or that if E_1, E_2,...E_n, be the equivalent of separate members of an isomorphous group, then $E_n = m\,E_1$, where m is an integer. Now it is evident that if we have two or more isomorphous groups, we may find the ratios indicated between the equivalents of the members of the group; or, indeed, we may obtain almost any ratios desired when the members of these groups are numerous. In fact, to find the relations pointed out by Mr. Lea, we have only to find one substance the equivalent of which is the same multiple of 3 or 4 that the equivalent of any other body is of 7; but the different physical and chemical characters of the bodies selected by Mr. Lea at once shows that this relation is purely accidental. In the pages referred to the magnesia group of metals is cited as exhibiting in some of its members these numerical relations; now the metals forming this isomorphous group have equivalents which are very nearly exact multiples of 4; thus,

		Received Equivalents.
Magnesium	3 × 4	12·10
Calcium	5 × 4	20·
Strontium	11 × 4	43·84
Barium	17 × 4	68·67
Lead	26 × 4	103·56

In the same way, in the isomorphous group of metals forming alums and having oxides R^2O^3, we find several members whose equivalents are very nearly multiples of 7:—

		Received Equivalents.
G.	1 × 7	6·97
Al	2 × 7	13·68
Fe	4 × 7	28·
Mn	4 × 7	27·57

We may from these two tables find several of the relations which have exercised Mr. Lea, and it would be easy, from the group of metalloids, chlorine, bromine, &c. to find the ratio 3 : 7, since the equivalents of these metalloids are near multiples of 6; thus,

	Received Equivalents.
H = 3 × 6	19·18
Cl = 6 × 6	35·45
Br = 13 × 6	78·26
Io = 21 × 6	125·33

Again, the metalloids S, Se, Ph, Te, have equivalents which are very nearly multiples of 8, and by taking other groups we may find not only the proportions pointed out by Mr. Lea, but many others having, however, no real interest or importance, inasmuch as the elementary bodies whose equivalents are found to bear these proportions to each other have in general no strict chemical analogies.—J. V.

TECHNICAL CHEMISTRY.

The Cause and Prevention of the Deterioration of Wrought Iron by Bri-Brachion.[1]

I have, during the last few years, paid great attention to the manufacture and nature of "wrought iron," and it is chiefly to one of the peculiar characteristics of this metal that I now wish to attract public notice. It is well known that iron, under some circumstances, loses entirely its cohesive power or strength, and becomes quite incapable of sustaining the force originally applied to it. Thus we see, not unfrequently, that a boiler which has worked safely for several years under a considerable pressure, suddenly bursts under even less than its accustomed load, and carries destruction all around it. Again, we perceive that a locomotive axle which has run for years under a great variety of conditions, gives way and snaps as if rotten, when least expected, and when least charged with weight. This peculiarity, as I have before remarked, has been long known, and has even excited the attention of scientific men; but no effort, that I am aware of, has been made to elucidate the conditions under which it arises, or to prevent its occurrence. This is the task to which I have devoted a large portion of my spare time during the last four years, and I must leave it for future observers to decide how far I have succeeded in removing so injurious a defect.

Without entering into a difficult scientific explanation of the phenomena connected with this loss of strength in wrought iron, I will content myself by making a brief quotation from the latest chemical writer upon the subject, in order that I may show what is really known as regards this matter. The author, or authors, are French, Messrs. Pelouze and Frémy, and the date of their observation 1854. In speaking of the nature of iron, they say: "Le fer fondu cristallise en cubes ou en octaèdres, quand on l'abandonne à un réfroidissement lent. Le fer peut même cristalliser sans perdre l'état solide; cette propriété exerce une grand influence sur sa ténacité. En effet, lorsqu'on soumet pendant un certain temps du fer nerveux à des vibrations fréquentes, il s'établit dans la masse un mouvement moléculaire qui détermine la cristallisation du métal. Il n'est pas rare de voir une barre de fer de très bonne qualité se transformer lentement, sous l'influence de vibrations souvent repétées, en fer cristallisé à grandes facettes; elle devient alors cassante et perd une grande partie de sa ténacité. Ce genre de cristallisation s'observe fréquemment dans le fer qui entre dans la construction des ponts suspendus, ou dans les essieux des voitures et de locomotives." I will thus translate the above quotation:—Iron, when melted and allowed to cool slowly, crystallises in cubes or in octahedrons. It may, however, be made to crystallise without losing the solid state, and this property exercises a great influence upon its tenacity or strength. In fact, when we submit for a certain time tough or fibrous iron to the action of repeated vibrations, a molecular movement is established in the mass which determines the crystallisation of the metal. And it is not rare to see a bar of the best iron transform itself slowly under the influence of frequently repeated vibrations into a highly crystallised iron, when it becomes brittle, and loses a great part of its strength. This kind of crystallisation occurs frequently in the iron employed in the construction of suspension bridges, and in the axles of carriages and locomotives.

Hence then it appears that the crystallisation of iron, and its loss of strength, are intimately associated together; and my experiments soon convinced me that the purer the iron the greater is its tendency to crystallise, consequently my efforts have been directed to the discovery of a means for preventing this disposition to assume the crystalline form, and I am happy to say that I believe that I have completely succeeded.

Every person conversant with the rudiments of chemistry is aware that one of the conditions most favourable for the development of crystallisation is the existence of purity, or, in other words, the absence of all foreign matter from the article which it is desired to render crystalline. With this view, the various alkaloids and other salts are rendered pure before they are set aside to crystallise, and hence too the mere presence of a distinct crystalline form is considered a good proof of purity. It will be, I dare say, remembered that the tendency of the stearic acid candles to crystallise was overcome in the first instance by the addition of a small quantity of arsenic, which noxious remedy was afterwards substituted by the employment of a little wax. Not many years ago, Mr. Hugh Lee Pattinson, of this town, discovered that when a mixture of lead and silver was fused and allowed to cool slowly, the lead crystallised, and thus separated from the mixture in a comparative state of purity, by which the amount of silver in the residue was proportionately increased. But I will not overcharge my arguments with proofs of a fact so well known: it is enough that impurity of any kind acts as an impediment to crystallisation. Two points, however, require to be gained in connection with this circumstance. First, is there any easy and practical method of determining when iron is pure? For, if so, we have at once a means of excluding all such iron from being employed in doubtful or dangerous cases. To this, I say, there is a method: iron, when pure, is attracted by the magnet, but immediately loses its magnetism when the magnet is removed, that is to say, pure iron does not acquire polarity. If, however, the iron is rendered impure by the presence of a minute quantity of carbon, oxygen, sulphur, phosphorus, or other matter, it retains the magnetic polarity, and by this simple means pure

[1] From the *Newcastle Journal* of Sept. 15. Our readers will notice that "Bri-Brachion" is the Greek for "Strong-Arm," and Sir W. Armstrong's celebrated gun factory is at Elswick, whence the above article is dated.

iron may be detected and separated from impure iron. This is the method which I have used in selecting samples for my experiments, and I have found it not only more easy, but also quite as conclusive as the most careful chemical analysis. The second point now remains: what is the best substance to employ as an agent for preventing the crystallisation of iron? I have tried carbon, manganese, cobalt, zinc, chromium, tin, and nickel, and I most decidedly give the preference to nickel, because all the other substances burn off or are oxidised in the puddling furnace during the manufacture of the wrought iron, and there is no practicable mode of uniting the iron with the particular substance in question, except this be done when the metal is in the state of pig-iron. The quantity of nickel which I have employed has varied from one part in five hundred to one per cent. My experiments upon the quality of the resulting iron have been conducted as follows:—The samples were forged into bars an inch square and twenty-four inches in length; these were fixed by one end near a wheel provided with a loose flapper, so arranged as to strike the free end of the bars about three times in a minute, and communicate to them a sharp vibration. This action was continued in every instance for six weeks, when the different bars were taken down and tested. The process of testing consisted in fixing one end of the bar in a vice, and adding weights gradually to a scale pan, which hung by a hook from the other end of the bar. The bars were tested until they began to bend before the experiment, and until they broke or completely bent after it. The results have thoroughly satisfied me of the correctness of the principle here advocated, and my preference for nickel as a non-crystallising agent has not been hastily formed, but I leave each person interested in this matter to select for himself. One fact as regards pure iron I have noticed which seems to merit general attention. A bar of the above dimensions was tested successfully with an 80 lb. weight before the vibratory experiment, and yet broke into three pieces by merely falling upon the floor after the experiment. It then exhibited at the fractured surfaces a bright and highly crystalline structure, similar to that of antimony. I therefore consider pure iron to be an extremely dangerous substance where any great change in its cohesive strength can lead to serious consequences, such as in the construction of steam boilers, gun barrels, railway axles, &c.

Elswick, Sept. 10th 1860.

On Adulteration and its proposed Remedy, by Wentworth Lascelles Scott.

Adulteration, in the more extended sense of the word, may be said to signify the addition to, or admixture with, articles of use and commerce, of any substance or substances foreign to their legitimate composition with a view of imparting to such articles a fictitious value, by diluting their active constituents merely, or by rendering them more attractive to the eye, or to the senses of taste and smell. Absolute purity being neither possible, nor, as a general rule, desirable in commercial products, it behoves us to consider how far adulteration should be permitted, and at what point the arm of the law should be extended to protect purchasers from the loss and injury inflicted upon them by fraudulent tradesmen.

The class of substances most liable to adulteration, of the pernicious and fraudulent kind, is precisely the one in which purity is of especial importance, viz.—the alimentary class. Here, not only the pockets of the public suffer, but the constitutions also, nay, sometimes even life is sacrificed by this despicable system of poisoning and robbery combined. Among the more recent instances of this, the Bradford lozenge case and that of the Clifton Bath buns will be remembered by all.

Alimentary adulteration may be most conveniently considered under the following heads:—

I. Those articles to which no after-addition has been made, but which are contaminated with various extraneous matters, owing to imperfect preparation or purification. Of this class various distilled spirits, oils, essences, &c. of commerce, wood-vinegar, certain prepared farinas, and brown sugar, may be quoted as examples.

II. Natural products, more or less unsuitable for food by reason of their being partially decomposed or prematurely collected, including almost every variety of meat, fish, fruit, vegetable, milk, eggs, &c. usually sold in the natural state or in a condition nearly approaching the same.

III. Articles whose inherent properties or active principles have been weakened or diluted by the addition of other substances of a comparatively negative character, and generally of considerably less commercial value. This division is an important one, as it amounts to distinct fraud on the part of the vendor. Examples will be familiar to everyone, such as milk, wines, and spirits, diluted with water; arrow-root, coffee, cocoa, mustard, honey, &c. &c. to which starches of inferior quality, sawdust, flour, chalk, clay, and a host of other substances, even more objectionable, are added in varying proportions.

IV. Articles, to which, their normal physical properties being diminished or obliterated by spontaneous eremacausis (see class II.), incautious preparation (class I.), or from previous adulteration of the diluent kind (class III.), various powerful flavouring or colouring matters have been added, in order to simulate the absent qualities they are required to possess. Thus bread is made from inferior, diseased, or adulterated flour, with the addition of alum[1] to impart that "*natural white colour*" which would otherwise be wanting. Again, cannot every reader of these pages point out instances of "fine cordial gin," first diluted with water, and then fictitiously strengthened by means of turpentine, pepper, capsicum, &c. &c.? Is not weak and inferior beer constantly falsified with cocculus indicus, nux vomica, wormwood, quassia, "grains of paradise," wood-spirit, salicine, some species of fungi (at present unknown to the writer), &c. to say nothing of a host of more innocent ingredients?

V. In this class may be placed those articles of food which, from the anxiety of the vendor to secure for them an ornamental or otherwise attractive appearance, are thus rendered dangerous, or at least injurious to health, in a greater or less degree. Confectioners and others have many sins to answer for in this division, for they *will* poison our unfortunate children with pretty looking sugar-plums, made of inferior sugar, mixed with chalk, clay, or plaster of Paris, *alias* "daft," to begin with, flavoured with various "fruit essences," still containing crude fusel oil perhaps, and coloured by gamboge, chrome yellow, iodide of lead, carbazotic acid, Prussian and other blues, red lead, red ochre, carbonate, acetate, and even *arsenite* of copper ("Scheele's green"), &c. &c.

VI. Under this head the rarer adulterations may be conveniently studied, such as those arising from unusual accidents, together with such barefaced impositions as

[1] In the experience of the writer both "borax" and phosphate of sodium *have been* tried for the same purpose.

imitation ginger-root, "vanilla," manufactured from a kind of bean pod treated with syrup, &c. heated and scented, the patent coffee berries (sawdust, &c. baked and moulded), and the famous "wooden nutmegs" of our transatlantic friends.

It must be evident to the sagacity of even a casual observer that the terrible state of things just indicated in the preceding lines places very grave difficulties in the way of remedial legislation, for while the safety of the public and outraged justice imperatively call for some protective measures, the "liberty of the subject," the "manufacturing interest," and "probable exaggeration of the evil," furnish arguments on the other side. It is far from my present purpose, and moreover it would be quite inappropriate to these pages to enter upon an abstract review of this very complex subject, suffice it to say that the only Act now practically in force against adulteration is that prohibiting the sale of mixtures of coffee and chicory, unless distinctly specified and sold *as such*. This is, of course, all very well, but the *proportion* of chicory to coffee need not be given; the "chicory" itself often contains 80 per cent. of common dandelion root, lime wood, or brickdust, and the purchaser has no authorised means of discovering the precise value of his "mixture of coffee and chicory."

Now let us turn to the "Act for Preventing the Adulteration of Articles of Food or Drink, August 6th, 1860," the chief provisions of which have already been laid before the readers of the Chemical News. That the Act is a good one, *as far as it goes*, seems to be the general, if not universal opinion, but it certainly does *not* go a very great way; such as it is, however, the public, to whom it may prove a boon of no ordinary magnitude and importance, should make the most of it, and leave required extensions until such time as the national progress shall render them inevitable. It is certainly to be regretted that the present Act does not include drugs or medicines of any kind, as these are fully as much adulterated as our "food or drink." Another fault will probably be found in the practical working, relating to foreign produce or imported articles generally, on which point the Act is entirely silent, and obstacles will doubtless be thrown in the way of justice by vendors declaring that articles imported by them were *not adulterated in this country*; this may be in many cases true (*e.g. tea* may be falsified in *China*), but as the Act stands this will not diminish the vendors' liability, for they may be convicted and punished for *selling* impure articles. A third error is evidenced by the fact that the official position and functions of the "Analytical Officer" are not well defined, but must be specially decided upon in every instance: the obligations of such an officer, if properly and conscientiously carried out, will not be few — his responsibilities by no means light. Nevertheless, attempts will doubtless be made in many places to invest the existing medical officer of health with the duties of public analyst as well, which, in the majority of instances, irrespective of hospital and private practice, must prove too much for him. The question too may very appropriately be asked — "How many of our medical officers are really competent to act as analysts?" Taking the Act in relation to its *intention*, more than as to what it actually expresses, the duties and restrictions of a public analyst may be thus defined: He should be incapable of accepting or holding any other *public* post, except it be of an honorary character: he should honourably fulfil the duties assigned to him by the Act of 23 & 24 Vict. cap. 84, and in addition to those, should make reports at stated times to the vestry, district board, or other body by whom he is appointed: he should make it his duty to examine privately the foods and drinks of his district in order that the authorities may be enabled to point out to the public what articles of food more especially require condemning: and he should be bound to furnish to any person, according his or her name and address and paying a certain nominal fee, a copy of any certificate of analysis granted by him previously. Further, he should give his scientific assistance in any public matter requiring it, such as the examination of all foods, drinks, medicines, general stores and building materials tendered or supplied for district purposes. Alarmed as the public mind has been from time to time upon the subject of adulteration by the disclosures of analysts and others, it has to a certain extent become accustomed to the evil, glaring as it is, and sometimes even indirectly encourages the sellers of sophisticated articles of food. For instance, how many people, when purchasing pickles, make a point of selecting the *greenest* to be found, ignorant or careless of the fact that the bright colour is due to the presence of copper, in the form of acetate; again, is not anchovy-paste generally preferred when of a fine red tint owing to an earthy paint, and flake-cocoa when looking especially rich, from an admixture of mutton fat or tallow? Still, however, Paterfamilias, like everybody else, is gradually getting wiser, and there can be no doubt but that he will gratefully accord to any sound and practical plan for the suppression of adulteration his earnest and vigorous support.

For the more perfect elucidation of the subject under consideration, and of my personal views upon the same, I append a table[1] of the more important, or typical "articles of food and drink," with the substances used for adulterating them — the latter being divided into six classes, in accordance with the definitions given in the earlier part of this paper. The results are derived from the best published authorities, the information kindly furnished by friends, or from the experiences of the writer. It is not of course attempted within these circumscribed limits to give more than a very general idea of food and its adulterants, but if the table referred to should hereafter suggest the compilation of others, far larger, more comprehensive, and detailed, its object will have been fully attained; such tables could hardly fail to prove useful and interesting to analysts, manufacturers, and the public at large.

The purely analytical part of the subject is of too extensive a character for me to enter upon here, but I cannot refrain from urging all experimenters to avoid the very common errors of relying solely upon chemical reactions on the one hand, or of trusting entirely to the revelations of the microscope on the other, when examining alimentary products, — either course is dangerous, and may lead to serious mistakes. Reviewing for a moment the classification of adulterants here suggested, the public analyst will see that those referable to the first division may be attributed to intentional fraud, or manipulative carelessness; in class II. the same observation to a certain extent applies, and the analyst must be guided by his own discretion, and by collateral circumstances, in framing his opinion and report upon each special case. In the two succeeding divisions (classes III. and IV.) it is merely a question of a greater or less degree of positive fraud and dishonesty — fully as much to be reprehended as if false (or "adulterated") weights were employed, — in many cases more so, as the charge

[1] The table will be given in our next number.

against a vendor of positively adulterated provisions may amount to one of manslaughter even. Adulteration under class V. will always require very careful consideration, as the point here to be decided is how far the artistic genius of a confectioner is to be allowed to carry him when he poisons us in the prettiest manner conceivable. The last division, consisting of exceptional cases, must be dealt with exceptionally — the charge to be preferred will probably be that of "obtaining money under false pretences."

As I have before asserted, adulteration is a widespread evil — a Hydra-headed monster of no mean proportions, existing almost as universally in the commercial, as attraction, or electricity, in the material, world; one section may now be crushed, in our country at least, if every one interested in its ruin will but bear a bold hand in the accomplishment. Enough for the present — we may risk all by attempting too much, but it may be interesting at some future time to consider the number of human beings who are prematurely hurried under the sod by the shameless falsification of the medicine that would otherwise heal their disease — to think how many of our gallant ships founder solely by the influence of *fibre-adulterants* in their canvas and rigging — in a word, to reflect upon how we are cruelly and systematically poisoned and defrauded all along the great Road of Life, from the cradle to the grave, and how we may best introduce the stern reforms so long and so greatly needed.

Brompton, London, S.W. Sept. 1860.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of Hypophosphorous Acid and the Hypophosphites.

(*Concluded from page 176.*)

Hypophosphites of Iron.—The hypophosphites of both the per- and prot-oxide of iron are used in medicine. The first is made by precipitating persulphate of iron with hypophosphite of soda. A gelatinous precipitate falls, which must be drained on a calico filter, washed with a small quantity of water, and then gently pressed and dried. When freshly precipitated, the hypophosphite of iron is soluble in water. After drying it becomes an amorphous white powder, which is freely soluble in hydrochloric and hypophosphorous acids. The hypophosphite of the protoxide is more permanent and soluble than the persalt, and is therefore preferable. They are most often prescribed in the form of syrups, formulæ for which are given below.

Hypophosphite of Quinine.—This salt may be prepared by digesting an excess of freshly precipitated quinine in hypophosphorous acid; or it may be obtained by the double decomposition of hypophosphite of lime and sulphate of quinine. In the latter case the precipitate must be carefully washed with but a small quantity of water, to avoid dissolving the sulphate of lime. On evaporating the filtrate the hypophosphite of quinine will be obtained in feathery tufts of crystals. It is soluble in 30 parts of cold water, and somewhat less of hot. The dose is from one to five grains.

The hypophosphites are mostly crystallisable salts. When heated in a test tube they give off phosphuretted hydrogen gas, which takes fire when it reaches the air. All are soluble in water, and several in alcohol also. When dry they are permanent in the air; but in a state of solution they oxidise when boiled in contact with the air, and change into simple phosphates. Alkaline hypophosphites dissolved in water, and containing an excess of alkali, are decomposed by boiling into hydrogen gas and a residual alkaline phosphate, the change taking place with greater rapidity in proportion as the alkali is stronger, its quantity greater, and the solution more highly concentrated.[1] The manufacture of the alkaline salts would appear to be attended with some danger, which may probably be avoided by evaporating the solution at a temperature never exceeding 212°.[2]

Compound Syrup of Hypophosphites.[3]

Take of hypophosphite of lime	.	256 grains
„ „ soda	.	192 „
„ „ potash	.	128 „
„ „ iron	.	96 „
„ hypophosphorous acid	q. s. or	240 „
„ white sugar	. . .	9 ounces
„ water a sufficient quantity.		

Dissolve the salts of lime, potash, and soda in six ounces of water, put the iron salt in a mortar, and gradually add hypophosphorous acid until it is dissolved; to this add the solution of the other salts after it has been rendered slightly acidulous with the same acid, and then water until the whole measures 12 ounces; add the sugar, and dissolve with a gentle heat.

The 96 grains of hypophosphite of iron are obtained when 128 grains of hypophosphite of soda are precipitated by a slight excess of persulphate of iron.

Syrup of Hypophosphites containing the Proto-salt of Iron.[4]

Take of hypophosphite of lime	.	256 grains
„ „ soda	.	192 „
„ „ potash	.	128 „
„ sulphate of iron, crystallised	.	185 „
„ carbonate of soda „	.	240 „
„ hypophosphorous acid, sp. gr. 1·036	. . . .	3½ fluid ozs.
„ sugar	. . . .	12 ounces.

Dissolve the protosulphate of iron and carbonate of soda each separately in four fluid ounces of water and mix the solutions. Wash the precipitated carbonate of iron thoroughly with sweetened water, and drain it on a muslin filter. Having placed the salts of lime and soda potash in a suitable porcelain dish, add about two fluid ounces of water and one fluid ounce of hypophosphorous acid; heat the mixture gently, and add the moist carbonate of iron in small quantities alternately with the hypophosphorous acid until the solution is complete. Add water to ten ounces, and dissolve the sugar.

Report of the Chemical Analysis in case of Poisoning by Strychnia, by Henry Letheby, *M.B.*

[The subject was a girl 18 years of age, who being taken with what was supposed to be a fit, was treated with calomel and scammony; afterwards, on suspicion of poisoning, an emetic of sulphate of zinc was administered.]

On Wednesday, the 9th of May 1860, I received from Mr. Edwards, the superintendent of police at Peterborough, two jars, three bottles, and a packet of Battle's vermin killer. One jar was labelled, "*Stomach and its contents, with a piece of the ileum and the head of the cæcum.*" The other jar was labelled, "*Contents of large and small intestines, and a piece of liver.*" One bottle contained about *two ounces of blood from the vessels of the neck.* Another bottle contained nearly *two ounces of urine;* and the third bottle contained, *eight ounces of the well-water used by the family for domestic purposes.*

[1] Gmelin, vol. ii. p. 114.
[2] See Chemical News, vol. ii. pp. 19, 46.
[3] Parrish, op. cit. p. 502.
[4] Op. cit. p. 503.

The stomach was cut open, and it floated in its contents with the two pieces of intestine. Except at the large end of the stomach, the mucous coat was healthy and natural; but at that end there was a nearly circular patch, about three inches in diameter, which was red, and showed marks of irritation. The two pieces of intestine were also cut open, but they were free from morbid appearance. The contents of the stomach amounted to two and a half ounces in quantity; they had the general consistence of gruel, were of a pale brown colour, and contained portions of partly digested meat, with bread, fat (like dripping), and fragments of tea-leaves. They had an acid reaction.

All these matters were first examined by the volatile tests, for hydrocyanic acid, but with negative results. They were then digested in alcohol, filtered, and examined for mineral poisons; but, as before, with negative results. The alcoholic solution was then precipitated with subecetate of lead, filtered, and decomposed with sulphuretted hydrogen. After the separation of sulphide of lead, the clear liquor was evaporated nearly to dryness, and the residue dissolved in about two ounces of distilled water; it was then filtered, in order to separate a few flakes of fat; and, after the addition of ammonia, so as to make it slightly alkaline, it was treated with successive portions of ether, using about four ounces of ether at a time. The ethereal solution was distilled, and there remained two grains and a half of a pale yellow resinoid matter, of an intensely bitter taste. A portion of this was dissolved in a drop of acetic acid, diluted with water, and injected into the peritoneum of a frog. In five minutes the animal was violently convulsed, and it died in fifteen minutes, after a succession of tetanic spasms. This experiment was repeated in the presence of Dr. Paley and Mr. Pearce, at Peterborough. Another portion of the resinoid matter was treated with a drop of concentrated sulphuric acid, and then with peroxide of manganese, by which means the characteristic reactions of strychnine were observed; but the effects were somewhat obscured by the presence of organic matter (probably sugar), which was darkened by the sulphuric acid. This was removed by adding ten drops of concentrated sulphuric acid to the remainder of the resinoid matter, and allowing it to stand in a warm place for three days, during which time all the impurities were charred. The black acid liquor was then diluted with water, supersaturated with ammonia, and again treated with ether. The ethereal solution gave, on evaporation, nearly pure strychnia, which weighed 0·6 grain. This exhibited a brilliant play of colours (purple to orange-red) with sulphuric acid and peroxide of manganese; and when a little of it was dissolved in a drop of sulphuric acid on platinum foil, and submitted to the action of a galvanic current by connecting the foil with the positive pole of a battery, and the acid with the negative, it produced a splendid purple blue, which is characteristic of the action of nascent oxygen on strychnia.

The solid matters from the stomach, which were left on the filter after the action of alcohol, were diffused through warm water and filtered. The clear solution was then treated with sulphuretted hydrogen, and it gave a dirty white precipitate, which I found to be sulphide of zinc. Lastly, the stomach and undissolved residue were boiled with dilute muriatic acid, in the presence of a strip of copper foil. The copper became coated with a silver-like layer of mercury; and when washed, dried, and heated in a glass tube, it yielded a globule of mercury, which was given to Dr. Paley.

The results of this investigation were, that the stomach contained strychnia, a preparation of zinc, and mercury.

The same treatment was applied to the contents of the intestines, and strychnia was also found in very small quantity.

The liver also yielded it in small proportion, as well as a trace of mercury.

The blood was examined in the same way, but with negative results; for not only was the ethereal residue free from bitter taste, but it had no action on a frog, although that animal is affected by the 0·0005 or the 1-2000th of a grain of strychnia.

The urine amounted to twenty-two fluid drachms. It had a very pale amber colour, was slightly acid to litmus-paper, and had a specific gravity of 1014. When it was boiled, it became very turbid, from the presence of albumen. It was precipitated with subacetate of lead, filtered, and the excess of lead removed by sulphuretted hydrogen. After the separation of the sulphide of lead, the clear solution was evaporated nearly to dryness. It was then treated with ether; and the ethereal solution gave a bitter residue, which in very small quantity convulsed a frog. The residue was acted on with a few drops of concentrated sulphuric acid, in order to destroy impurities. The strychnia which was then obtained was nearly pure. It weighed 0·3 grain, and gave, with sulphuric acid and peroxide of manganese, as well as with the galvanic test, the brilliant reactions of strychnia. Three frogs were convulsed with it in less than five minutes, and were dead in from ten minutes to a quarter of an hour.

These results are highly satisfactory, for they furnished undoubted evidence of the absorption of strychnia during life, and the secretion of the poison unchanged with the urine.

Lastly, I found that the packet of powder, marked "Battle's Vermin-killer," consisted of flour, a little sugar, strychnia, and Prussian blue. Ten grains of the powder furnished to ether 2·3 grains of strychnia—a quantity that represents 23 per cent. of the poison.

The chief points of interest in this investigation are—

1. Strychnia was easily detected in the stomach, notwithstanding that the dose taken must have been small, if we may judge from the long duration of the symptoms. In this respect, the results accord with every case of strychnia poisoning I have had to investigate.

2. The cutting open of the stomach, and the shaking of it about with its contents in a jar, had no influence whatever in the success of the analysis.

3. The urine contained the poison in large quantity, notwithstanding that the blood from the jugular veins showed no trace of it — a circumstance that would indicate a rapid elimination of the alkaloid by the kidneys.

Remarks by Dr. W. Paley. It was proved at the inquest that the girl herself bought a packet of "Battle's Vermin-killer" the day before she died; and that she gave some bread and butter to her brother, who had the fits of stiffness, but recovered about twenty minutes after their occurrence. The poison was probably not taken at breakfast mixed with the food, as no other members of the family, all of whom partook of the same, were affected; and the whole remaining portion of it was given to different animals, with a negative result. My own opinion is, that she took it intentionally, either just before she left her home, about eleven, or even in the chapel. Supposing the former to be true, the unusual length of time—viz. three-quarters of an hour—which elapsed before its effects were produced arose,

most likely, from the stomach being full at the time of meat and fatty matter. It is probably from the same cause that the absorption of the poison into the system was so slow, and that death was deferred for nearly six hours.

In this highly interesting case, Mr. Pearce and myself had the rare opportunity of closely watching, for more than three hours, the symptoms produced by a poisonous dose of strychnine. Mr. Pearce was with her during three of the principal attacks; and I was with her during two, including the last fatal one.

On reviewing the case, I should say that the peculiar symptoms which led us to feel confident she was poisoned, notwithstanding the most positive assurance both from the patient herself and her parents to the contrary, were—1. The singular fact that three members of one family had all suffered from fits within so short a period. 2. The very peculiar convulsive twitchings of the limbs, brought on by either touch or noise. 3. The severe paroxysms of tetanic rigidity, not permanent, as in true tetanus, but coming on at intervals. 4. The perfect consciousness of the patient throughout the whole attack, with the exception of the very brief periods whilst the respiration was suspended. 5. The death by suffocation, and the rigidity afterwards. 6. That the symptoms, taken together, did not resemble those produced by any known disease.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

LECTURE VI. *On the Decay and Preservation of Building Materials, by* D. T. ANSTED, *Esq. M.A. F.R.S.*

THE subject of my present lecture is eminently practical, and hardly admits of much variety of illustration; but I am sure that none of you can have examined, or even glanced at the numerous specimens of architectural construction in the older and more picturesque cities of England and the Continent—you cannot have admired the graceful tracery of Westminster Abbey,—you cannot even have looked at the rich detail of the noble building recently erected so near it, by one whose genius will, perhaps, be willingly acknowledged, now that he has departed from amongst us, without noticing the facts I am about to refer to.

You will there see, at every turn, fresh proof of apparently capricious and unaccountable decay. You will find many old stones unaltered, while many new ones are mouldering fast into rottenness; and you will, I believe, be interested, in spite of the apparent dryness of the subject, in anything that will inform you about a result so painful, so irregular, and so desirable to check, if in any way its prevention is possible.

Our building materials are of several kinds. Let me point out to you the principal varieties—their peculiar uses—their relative value for special purposes—and the special causes of decay in each. I shall then endeavour to put before you the modes by which such materials may be, at least in some measure, preserved from decay.

There is one thing which I may say with regard to all building materials of the nature of stone,—namely, that wherever it is found forming part of the earth's crust as a mass of rock, it is invariably,—if it comes to the surface at all—injured and altered near the surface. In a granite district, for example, where there is scarcely any soil lying over the granite, it scarcely ever happens that the upper portion of the granite does not, to a certain extent, exhibit marks of alteration. In all the common absorbent stones which are ordinarily used for building purposes, this is much more remarkably the case. And, to a certain extent, the rate at which the stone would be injured may be estimated by its appearance where it has been thus exposed for a long time to the action of the atmosphere. But that can only be taken as a partial measure of the injury likely to occur, because in some cases it will happen that stone will stand exposure perfectly well in its own atmosphere, and when the surface only is exposed, without having been removed from the bed, although that same stone, when it is removed from the bed, particularly when it is placed in a different position from that which it occupied in the bed, will decay much more rapidly. Still, as I have said, it is an indication, and you will generally find that in a granite district, a surface of good granite is exceedingly hard close to the top, and a decomposing granite worn and rotten. In a sandstone district there will also be a certain amount of decomposition dependent on the value of the stone. And in a limestone district there will generally be considerable decomposition; in fact, the whole of the upper bed of limestone will be converted into vegetable soil.

Let us now take the building materials in regular order. First of all there is the group of which granite is the representative. A very remarkable group of stones is this, which are perfectly familiar to everyone. With respect to it, therefore, I shall not waste your time in definitions, and merely remark that as it is one of the hardest, and, in some respects, one of the most valuable stones we have, yet in many respects, although very useful, it is almost impracticable for delicate ornamentation. Granite consists of a number of crystals embedded in a crystalline base. In other words, it is a mass of crystalline minerals crystallised altogether. That is the essential nature of granite, and the point in which it differs from most other stones. This explains at once its value, and the nature of its decay. Its value, because granite, being composed entirely of crystallised matter, is non-absorbent, and very little exposed to injury, so that there is no opportunity for decomposing agents to get to it, without the lapse of a very long period of time. But it is also necessary to observe that granite consists of various kinds of crystals, and these not being always composed in the same manner, some are more liable to decay than others. Among the crystals that form granite are crystals of quartz, a material so durable that one hardly expects it to fail at all. But quartz, under certain circumstances, is capable of assuming a state in which, by the action of the weather, it will decay. This very peculiar state I shall speak of afterwards, when I have to ask your attention to some means of preventing decay. It is a fact—and I allude to it now as one of the ways in which granite appears subject to decay. A portion of quartz seems to be liable, in some states, to combine with water; and it then can be acted upon by alkalis and alkaline carbonates. More frequently it is the crystals of felspar, of which granite also consists in a large measure, that decay. These consist of compound silicates, and the alkali among them is generally potash, but occasionally soda. When the alkali is soda, the stone is more likely to decay than when it is potash. Mica or talc, the other constituent of granite, is in a similar way liable to decomposition. Thus, although granite, as a stone, seems scarcely liable to injury, yet all the different parts of it are really capable of decay. With regard to the prevention of granite from decay, I do not know that it has ever been attempted. The only thing to be done is to select the better kinds, and you have only to go to the British Museum, and look at those wonderful specimens which have been delicately sculptured by the Egyptians, and afterwards exposed for so many centuries to a dry atmosphere, and now for some years to our own moist atmosphere, to observe how totally untouched they are. You have only to look at the various specimens of granite in our own metropolis, or in other parts of our island, and you cannot fail of being convinced how well it stands generally, although you may occasionally find unfavourable specimens.

Granite is a material which, owing to its great hardness,

requires to be worked by pick and wedge; it cannot be worked merely by chisel and mallet. Owing to that it is expensive, and, generally speaking, cannot be used for ordinary purposes.

Next we come to the group of freestones. Freestones are either sandstones or limestones. The sandstones form a large group, but they are not very extensively used for the more decorative parts of buildings. They are at any rate little used in London, and there are many reasons for this. Sandstone consists for the most part of quartz sand, and I have told you that quartz forms a larger part of granite. But the particles of quartz in sandstone are cemented together by some foreign combining substance; sometimes this substance is silica, and in that case the stone will be almost unchangeable. Such is the sandstone that is worked in Edinburgh, and obtained at Craigleith. It is a stone which scarcely injures by exposure. Most of the sandstones, however, are cemented together, either by carbonate of lime, which has been filtered in by the action of water, by a mixture of clay and carbonate of lime introduced in the same manner, or by the presence of oxide of iron. All these cementing media are of course liable to the action of foreign substances upon them, according to their nature. And if these give way it is clear that the stone itself must give way. For an example of this kind of stone, that scarcely changes at all, I may direct your attention to a few specimens of the Yorkshire stones on the table before you. Although very excellent, however, these stones are not very manageable. They are difficult to work, and very hard. Although very durable they vary, and are not quite free from the ordinary faults of sandstone. There is also before you a specimen of red stone (Mansfield) in which there is a considerable quantity of iron. The others are silica, with some mica, and are cemented by calcareous and argillaceous matter. They are thus liable to the ordinary action of weather and foreign substances upon them. In these stones the particles of silica rarely, if ever, give way, but they are liable to fall away from each other by the decomposition of their cementing medium. But I was going to speak of the several kinds of sandstone before going into the causes of decay. The Yorkshire stones are the next in value after Craigleith, and are very good. Some of the dark coloured Scotch stones are also excellent. The stones from the coal measures are better than these red ones, which are not by any means advisable, and require to be used with care. There are a number of varieties of these red sandstones. All the sandstones used may be grouped in these three ways:—Those that are very hard, very compact, very fine in grain, and, generally speaking, of a pale colour; these are durable, but costly. Next, there are those that are hard and laminated. That is the character which belongs to almost all rocks that have been found in water, but in some it shows itself more markedly than in others. In stones which are completely laminated, the appearance is like sheets of paper placed one over the other, and you can almost separate them. Those stones are easily perishable. There are, however, laminated stones, such as those I am now referring to, of good quality. These are generally not of very fine grain, although they may be so. They are most frequently of a mixed grain, made up of particles of sand and small pebbles of different sizes. Very often they have reddish tints of colour, owing to the presence of iron, and they are often very irregular in their character. Lastly, there are some soft stones which are laminated, and generally red, but soft and bad. These are the three kinds of stone.

All these stones are subject to decay in this way:—First, from the lamination. Having been formed in water, they have been deposited in beds one over the other, and never become entirely free from water, and when exposed to the air liable to give off the water by evaporation, and take it in again by absorption when rain comes, or when the atmosphere is damp. After this, if a change of temperature follows, and a severe cold sets in, the temperature of the stone passing below the point of the extreme density of water, the water begins to expand. That expansion, before and whilst freezing, is one of the properties of water with which you are probably acquainted. You all know that if you leave water in a jug with a narrow neck, and frost sets in, the water will expand and break the jug. In the same way laminated and absorbent stones will break. The water gets in but cannot get out freely. It expands, and the stone breaks. Secondly, water entering in the manner I have described contains foreign substances. The water in the atmosphere that falls in the shape of rain is absorbed into the stone, and necessarily contains those foreign substances floating in the atmosphere which are soluble in water. These substances include a large number of gases,—acid gases for the most part—but some others. For example, they include carbonic acid gas, and carbonic acid dissolves in water; they include, also, sulphurous acid passing into sulphuric acid, this is taken up by the water. They include, also, ammonia. All these substances are abundantly produced in the atmosphere of large towns. These substances entering into the body of the stone, begin to act upon the cementing medium. If the cementing medium is easily acted on chemically by these substances, it is of course very soon removed. If it is not easily affected by them, then the stone remains unaltered; but, generally speaking, it is the case that sandstones that have either lime or clay as their cementing medium, are more or less affected by foreign substances entering into them through the atmosphere. There is then a cause of decay in the sandstones, and the sandstones, when they are very absorbent, generally become readily disintegrated in this manner. Sandstones are not very extensively used in London for building, but they are very much employed in many parts of the country.

(To be continued.)

NOTICES OF BOOKS, PATENTS, &c.

A Cyclopædia of the Physical Sciences, comprising Acoustics, Astronomy, Electricity, Heat, Magnetism, Optics, &c. &c. by J. P. Nichol, *L.L.D. with the assistance of eminent scientific men.* Second Edition. R. Griffin & Co. London and Glasgow, 1860.

The publication of a second edition of this work in the course of three years, is a higher testimonial to its merits than any praise we could give, great as it would necessarily be. Although not absolutely faultless, as its lamented author was well aware, it yet presents to the student a larger amount of information concerning the condition and progress of physical science than any other single English volume.

It is the misfortune of books on science, and of cyclopædias in particular in these days, that they are quickly out of date. The progress of discovery is so rapid, facts accumulate so fast, speculation is so rife that the standard work of one year is left far behind in the next; and although this is not so much the case with the physical sciences, commonly so called, as with chemistry, it is only necessary to compare the two editions of this work to see how much advance has been made even in these in the course of three years.

We turn to article Aerolites for the most recent information and speculations concerning these bodies. "The nature of these masses has been determined by chemical analysis. They contain the following elements: — Oxygen, hydrogen, sulphur, phosphorus, carbon, silica, chromium, potassium, sodium, calcium, magnesium, aluminium, iron, magnetic nickel, copper and tin. The following are the chief types in which these elements are found combined: — *Metallic iron* containing small quantities of nickel, cobalt, magnesium, manganese, tin, copper, sulphur, carbon.— 2. *Sulphuret of iron.*—3. *Magnetic iron.*—4. *Olivine.*—5. *Silicates* and other earthy substances. — *Chromate of lime* in small quantities. — 7. *Oxide of tin.* In one Wöhler found a small quantity of organic matter akin to paraffine: — a fact wholly unexpected and going far to prove the planetary character of these

singular masses." With regard to their origin several hypotheses have been proposed, the latest being that of Reichenbach, which has been introduced in this edition. Reichenbach supposes that they are comets which have passed by condensation from an impalpable dust to a solid sate. An analysis of 140 aerolites showed Reichenbach that they consist for the most part of very small spheres or spherules united by an amorphous substance; or what is nearly the same thing, that they are aggregates of millions of spherules, at one time probably existing freely and apart in space; and a comet according to his idea is merely a swarm of solid grains or molecules far from each other, exceedingly light, transparent, luminous by reflexion, perfectly mobile and floating through empty space. The composition of these bodies, as we have seen, closely resembles that of our volcanic rocks, and Reichenbach speculates that the earth may be a mass of aerolites. Twelve, at least, he says, fall on the earth daily, or 4500 a year. Some are small, and some as large as a house or a small hill. The mean specific gravity of them is rigorously equal to that of the earth, so that on every side there seems to be a relationship between these two formations. We must leave these speculations to the astronomers, whom they more immediately concern, but we quote from the astronomical articles because they are the production of the lamented editor himself, and are certainly among the best in the book. We might instance several; but that on the physical constitution of the moon is especially interesting. The peculiar circumstances distinguishing the moon's motion of rotation have enabled astronomers to determine that the interior of our satellite is heterogenous, and that its centre of gravity does not coincide with its centre of figure. The centre of the moon's figure is nearer to us than its centre of gravity. The physical meaning of the separation of the two centres is simply this — the hemisphere towards the earth is lighter than the hemisphere turned away from us. Dr. Nichol shortly describes the necessary consequences of this discrepancy as to level, climate, and all physical relations connected with these, for which we must refer our readers to the article itself; but as many may have often wished to see the other side of the moon, we quote the Doctor's account of what it may be like. "The face that is turned from the earth may be varied even like the regions around us. Oceans or seas may cover portions of its surface, refreshing breezes may fan it all, and it may be occupied by those very forms of animal and vegetable life which our own experience shows to befit the cosmical relations of the compartment of space common to us and to the moon. On that face of our luminary which alone we can see, it were folly to expect traces of anything so agreeable. The conditions under which it exists — as we learn from inexorable science — suggest the picture of a surface, rocky, arid, and lifeless, three and a half times more extensive than our own inhospitable Sahara."

The articles on Electricity and Magnetism are very full and good, and have been well brought up to the present state of knowledge on the subjects, and among the new contributions to this edition is an article on the "Conservation of Force" by Professor Rankine, which however might well have been a little extended.

But taking it altogether, we can confidently recommend the *Cyclopædia of the Physical Sciences* as a work in which the student will find almost all he may wish to know respecting the sciences of which it treats.

CORRESPONDENCE.

Remarks on Dr. Hofmann's Miscellaneous Observations.

To the Editor of the Chemical News.

Sir,— From a contribution to the *Quarterly Journal of the Chemical Society* for April 1860, entitled *Miscellaneous Observations*, by Dr. A. W. Hofmann, of which you published an extract in your last week's issue of the Chemical News, it would appear that the eminent author laboured under misapprehension with regard to the want of due appreciation by his fellow chemists of certain methods of analysis which, as items 18 and 19, formed part of the said "Observations."

Conceiving that Dr. Hofmann's remark on his inability to find any notice in analytical manuals of the solubility of sulphide of cadmium in boiling dilute sulphuric acid must have been the result of a superficial inquiry, and was scarcely chargeable to the imperfection of our scientific records, I have taken an occasion of satisfying my impressions on this by direct reference to works devoted to the subject of analytical chemistry.

Firstly I remembered hearing that a method of separating copper and cadmium based on this principle was in common use amongst the students of the Royal College of Chemistry as early as 1852, and on referring to Abel and Bloxam's *Handbook*, published in 1853, I find the method incorporated into the tables, and a special remark appended (note 6, page 606), in acknowledgment of "its having been devised by Dr. Hofmann, and of its perfect success." Since that date it has to my own knowledge been generally practised in the London laboratories; it may also be found (particularly specified as Hofmann's method) in [the excellent tabular compilation of Dr. Griffin. These circumstances all make it impossible for so efficient a method, which has outlived eight years' progress of analytical chemistry, to have fallen into oblivion.

Dr. Hofmann's process for detecting antimony in the presence of arsenic (*Miscellaneous Observations*, note 19), has also been in the hands of the analytical chemist now more than seven years.—I am, &c.

F. C. S.

Sale of Poisons.

To the Editor of the Chemical News.

Sir,—I would not have ventured upon occupying more of your space with this subject, had not your publication of "Pro Bono Publico's" request implied that you were willing to hear more of my views upon the matter.

I claim no originality; every idea here advanced may have been published before. They are simply mine inasmuch as I have adopted them, from whatever source they originated, believing them to be the least objectionable which have yet been offered.

I think a poison bill ought to provide that —

Every retailer of poison shall be licensed.

Any one retailing poisons without license to be fined as in other breaches of license law.

Any accidental or criminal poisoning occurring through the retailing of poison by an unlicensed person, the said person to be subject to trial for manslaughter.

Licenses shall be granted only to apothecaries and pharmaceutical chemists, provided nevertheless that all chemists and druggists not being pharmaceutical chemists who are in business at the time of the passing of the Act, shall be entitled to take the license on the production of evidence to show that they were retailing drugs, and had assumed the title of chemist, or druggist, before the date of the Act.

For the purposes of the Act poison shall mean any substance which when taken in dose of 60 grains, is liable to cause the death of an adult, by a means not mechanical. Also it shall mean such other substances as may be enumerated in a schedule (*e.g.* laudanum, tinct. digitalis, &c. &c.), and except such other substances as may be enumerated in another schedule (*e.g.* lucifer matches, tobacco, colours ground in oil, &c. &c.)

Licensed dealers in poisons to be liable to a fine of £ if convicted of culpable negligence, which has resulted in death or grievous bodily harm. For a second conviction the fine to be doubled, and for a third the license to be forfeited. For the first conviction of a servant the servant only shall be fined, for the second conviction of the same servant if in the employment of the same master, the master also shall be fined, and for the third conviction of the same ser-

vant, if still in the employment of the same master, the servant shall be fined and the master forfeit his license.

It is doubtful whether a definition of a poison, or a list of poisons would be found most practicable. For the purposes of an act of this nature a very copious list would be required, but the restrictions being so slight, its fullness would not be objectionable, though it would have the disadvantage of requiring constant additions.

Licensing has been objected to on the ground that those holding the license would be apt to think that they were absolved from farther responsibility so long as they paid the license, and adhered to the letter of the law, they would be liable to push the poison-trade and neglect reasonable precautions. I think a poison bill framed upon the principles roughly sketched above, would be free from these objections; it would gradually but surely effect all we may at present look for from legislation, and not meet with any formidable opposition. It must be admitted that it would be slow in producing the change, but on the other hand the number of deaths from criminal and accidental poisoning is not so great compared with the criminal and accidental deaths from other causes, as to demand any convulsive legislation.

Had regulations of this nature been put in force when poison bills were first agitated, or when the Pharmaceutical Society first attempted to raise the standard of qualification of those who have to deal in dangerous drugs, there would by this time have been few of the careless and ignorant poison dealers, now too numerous, and those few speedily dying out. I would not be supposed to stigmatise the class of "chemists and druggists not being pharmaceutical chemists," as careless and ignorant, though unfortunately the title of chemist and druggist will include many unworthy of the name.

All who are interested in legislation upon this subject would do well to read the many articles which have been published in the *Pharmaceutical Journal* since Feb. 1845, but more especirlly those in vol. viii. and vol. ix., giving various views of the matter as seen from different positions.

If PRO BONO PUBLICO has not ready access to the *Pharmaceutical Journal*, or desires any farther information within my power to give, I will be happy to communicate with her by post.—I am, &c.

BARNARD S. PROCTOR.

Grey Street, Newcastle-on-Tyne Sept. 1860.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Contributions to the History of Oxygen.—Schönbein continues[1] his interesting investigations on the production of the binoxide of hydrogen by the slow oxidation of metals. He finds that when pure water is shaken with tin, or an amalgam of tin, in the presence of air, none of the binoxide is produced, but the addition of a very small quantity of sulphuric acid immediately induces the formation of some. Neither bismuth, an amalgam of iron, or of chromium, aluminium, nor amalgams of cobalt, nickel, or manganese, give rise to the formation of the binoxide when agitated with pure water in the presence of air. Mercury, silver, gold, and platinum never give a trace either with pure or acidulated water. Schönbein thinks that all except the noble metals ought to produce the binoxide by their slow oxidation in moist oxygen. There may be cases, however, like that of arsenic, in which it may be impossible to prove the formation, on account of the decomposition of the binoxide as soon as formed to oxidise the metal.

Transformation of inactive into active Oxygen. Löwenthal has already shown that the bichromate and permanganate of potash favour the absorption, by protochloride of tin, of the oxygen dissolved in water, and he accounts for the fact by supposing that these salts render the oxygen active. He has since made some experiments to find out what other bodies possess the same power.[2] He first noticed that a current of air might be passed into a solution of the protochloride for forty minutes without affecting the strength of the solution.

Bromine, chlorine, iodine, and the chloride of lime have not the power of transforming inactive into active oxygen.

Chlorous acid, hypochloric acid, and phosphate of peroxide of manganese act like the permanganate of potash, in the presence of the protochloride of tin.

Molybdic acid behaves in a very peculiar way. If we add 5 or 10 cubic centimetres of hydrochloric acid and a sufficient quantity of molybdate of soda to 2 pints of water, and then add a known quantity of protochloride of tin, the estimation by means of the permanganate of potash will give the exact strength of the solution; but on adding more of the protochloride to the same mixture, another trial with the permanganate will show less tin than in the first experiment. The previous addition of some bichloride of copper will prevent these differences.

Variations of temperature between +3° and +30°, do not interfere with the change of the inactive into active oxygen, under the influence of the permanganates.

One most curious fact which the author announces is that the active oxygen so formed, has the power of communicating its activity to other portions of oxygen when dissolved. He thinks too that he has discovered a new allotropic condition of oxygen, besides that already discovered by Schönbein.

With regard to the oxygen dissolved in oil of turpentine, Löwenthal believes that it is disengaged by oxygenated salts in consequence of some catalytic action, and he asserts that it is set free in the active, and not in the inactive condition, as Schönbein states.

II. ORGANIC CHEMISTRY.

Action of an Amalgam of Sodium on Oxalic Ether.—Sodium by itself acts on oxalic ether in the presence of water, setting free carbonic oxide, and forming carbonic ether. The mixture soon becomes of a deep brown colour, and an acid is produced which has received the name *myrinic acid*.

If, says Löwig[3], the sodium be replaced by its amalgam in powder, the reaction is very different.

In this case a white salt, oxalate of soda, is deposited, only a few bubbles of carbonic oxide escape, and not a trace of carbonic ether is produced. If the vessel be well cooled, the crystalline mass is but slightly coloured. When redissolved in water it makes a colourless solution, which, shaken with ether, gives up to the latter a neutral body with a sharp taste.

The etherial solution on evaporation yields a syrupy liquid from which, after two or three days, beautiful white crystals separate, soluble in water and alcohol, and possessing the same sharp taste as the oily liquid. Their composition is expressed by the empirical formula $C_4H_3O_3$.

Composition and Properties of Oxalate of Copper.—This salt is described by Löwe.[4] Oxalic acid in slight excess completely precipitates a solution of sulphate of copper. The oxalate of copper is deposited after some time. As it easily passes through a single filter, the paper must always be double. When properly filtered, the filtrate will not contain a trace of copper. Dried between folds of blotting paper, the salt presents itself as a fine powder, of a bright greenish-blue colour. It is insoluble in oxalic acid, and also in dilute hydrochloric and nitric acids. Caustic ammonia dissolves it and forms a blue solution, which after some time yields prismatic crystals of a clear blue colour.

Oxalate of copper cannot be obtained in the anhydrous state even by heating to 120° C. At a higher temperature it begins to decompose. Dried in the air on filtering paper it yields on analysis results which answer to the formula,

$$2(CuO.C_2O_3) + HO.$$

[1] *Journ. f. prakt. Chem.* Bd. lxxix. s. 473.

[2] *Ibid.* 473. [3] *Ibid.* s. 455. [4] *Ibid.* s. 425.

III. ANALYTICAL CHEMISTRY.

Estimation of Nitric Acid in Rough Saltpetre. — According to Müller[5] this estimation may be made by transforming the nitrate of potash into chloride of potassium by means of hot hydrochloric acid, the heat being continued until the vapour which is evolved no longer affects ozone paper. The chloride is weighed after calcination: it must be perfectly neutral.

Coloration of Turmeric by Molybdic Acid. — Müller also points out that a solution of molybdate of ammonia in hydrochloric acid colours turmeric paper a brownish-red like boracic acid, the shade of colour however is somewhat different.

Estimation of the Constituents of Milk. — Daubrawa gives some new methods of estimating the constituents of milk.[6] Caseine, he states, is completely precipitated by salts of mercury, in the nearly constant proportion of 5 equivalents of caseine for each equivalent of oxide of mercury employed. In this way the caseine may be easily estimated by a standard mercuric solution, and the sugar of milk by a standard solution of copper, or even by determining the specific gravity. The author, however, prefers in practice the following method. A given volume of milk is mixed with twice its volume of alcohol of 85° (Cartier), which precipitates the caseine and butter together, in such a state that they may be estimated by measuring their volume in a graduated tube. The filtered solution has a density different from the density 0·9005, which would be that of a mixture of alcohol and pure water, and this density will increase by 0·094 for every hundredth of sugar of milk contained in the liquid examined. The necessary corrections for variations of temperature may be made by the tables arranged for mixtures of alcohol and water. We may determine in this way, with sufficient accuracy for ordinary cases, the amount of the principal elements contained in milk.

Separation of Urea from Urine. — A solution of ammoniacal nitrate of copper, M. de Luna has noticed,[7] completely decolorises urine, giving a precipitate which contains all the albumenoid and colouring matters of that fluid. The perfectly colourless filtered liquid serves excellently for the preparation of urea.

MISCELLANEOUS.

The Adulteration Bill in the City.—At the usual weekly meeting of the City Commissioners of Sewers on Tuesday last, Deputy Lott asked if any, and what action, had been taken by the committee of the Court to whom the new Act to Prevent the Adulteration of Food had been referred, with the view to give practical effect to it in the City? The Chairman said the subject was partially mooted at a recent meeting of the committee, and adjourned until Dr. Letheby could attend and confer with them on the matter. Deputy Lott said no Act more calculated to benefit the community had passed the legislature for some time, and he trusted that the Court would do what in them lay to bring it into practical operation within their jurisdiction.

A Malleable Amalgam for Dentists. — As to the brittleness which cadmium is said to communicate when combined with any other metal, the facts are, *some* of its alloys, even with malleable metals, *are* "brittle." But others are highly tenacious and malleable. Its alloys with gold, platinum, and copper afford instances of the former. Its combinations with lead, tin, and to a certain extent with silver and mercury, are examples of the latter. An alloy of two parts silver and one of cadmium is perfectly malleable and very hard and strong; with equal parts of each it is also malleable, but possesses less tenacity; but when mixed in the proportions of two parts of cadmium and one part of silver it is brittle. Equal parts of cadmium and mercury form a tough and highly malleable composition; in the proportion of two parts of the latter to one of the former, the amalgam is nearly equal in malleability, but possesses less strength. These mixtures are remarkable in view of the fact that most amalgams are exceedingly frail and brittle. A mixture of two or three parts of tin with one part of mercury is so fragile as almost to drop to pieces in handling; the amalgams with lead, bismuth, &c. are similar.

Alteration of the Hardness of Iron by Magnetism.—If a piece of iron that may be readily filed is put in contact with a powerful magnet, great difficulty will be felt in filing it when in this position. The strength of iron under such circumstance should be tested: and trials should be made to ascertain whether magnetism is induced in twisted gun barrels, and whether such condition adds to their strength. Magnetism may be induced in a gun barrel by a helix of copper wire wound round it, through which wire a current of electricity is passing. Let its strength in this condition be compared with a similar barrel under ordinary circumstances.

[5] *Ibid.* Bd. lxxx. s. 118.
[6] *Sitzb. der Akad. der Wissenschaft zu Wien*, Bd. xxxvii.; *Journ. für prakt. Chem.* Bd. lxxviii. s. 426.
[7] *Répert. de Chim. pure et appliqué*, Sept. 1860. p. 232.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

The next number of the Chemical News will contain a comprehensive Table prepared by Mr. W. L. Scott, exhibiting at a glance the various adulterations practised with articles of food and drink.

G. A. R.—Received with thanks. We shall always feel greatly obliged by similar communications.

A Subscriber.—A drachm in England is 60 grains, and in an English work such a drachm would always be meant. In Ireland, however, it is possible that a writer might mean 54·68 grains. You are no doubt right to take the ounce at 480 grains. The question, as you say, is important to physicians, and will soon receive a good deal of discussion. Thanks for the suggestion.

P. P. P.—We believe not; but a precipitate ought always to be washed free from the chloride before it is ignited.

Soap Maker.—1. It might be done by evaporating and then distilling with high pressure steam.—2. Pure, about 3*s.* a pound.

C. E.—1. Hopkin & Williams, 5 New Cavendish Street. 2. The separation cannot be accomplished without precipitating the tin, which may be done by neutralising the liquor with ammonia, and then adding sulphite of ammonia. The tin will be precipitated, and the iron will remain in solution, and can be used for the purpose you mention.

A Subscriber (Bristol).—We are sorry that we have not been able to procure any information on the point.

Mureeine. — For Gmelin's *Chemistry* apply to Harrison, publisher, Pall Mall. The other questions next week.

Want of space again compels us to defer the communications of Messrs. Horsley and Jenkins, and of *Junius* and *Ultimatum*.

Vol. I. of the Chemical News, containing a copious index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnaudon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, Baillière, 219 Regent Street, London.

THE CHEMICAL NEWS.

VOL. II. No. 44. — October 6, 1860.

THE ADULTERATION BILL IN THE CITY.

WE are happy to be able to announce that the City Commissioners of Sewers have unanimously resolved to adopt the Act for preventing the Adulteration of Food and Drink. The resolution does them great credit, but the refusal would have been a greater disgrace. It is an extraordinary circumstance in legislation, and an example which we hope will never be followed, that an Act of Parliament for the prevention of fraud should be only permissive. What, we may ask, is the moral difference between the negotiation of a forged bill of exchange and the sale of a worthless for, and at the price of, a valuable article? And in what does the certain and serious injury to the body, which may result from the ingestion of a poisonous substance, differ from that which may be occasioned by a common assault? And what would be thought of an Act of Parliament which made the punishment or prevention of assault and forgery dependent on the will of a local board? It may be answered, that such an act would be sure to be adopted. But how, if the adoption depended on the will of many who might possibly profit by the non-adoption?

It may be thought invidious to continue this line of argument, and we willingly quit it for the more pleasant task of congratulating the public and profession on the resolution adopted. The object of the Act is not so much punishment as prevention, and this happily it is very easy to accomplish. The adulterator will now be in constant fear of detection and exposure, which, in the absence of a higher moral feeling, will probably deter him from continuing his nefarious practice. If not, it will be the fault of the public if the Act be not put in force against him; and beyond this it must be remembered that the common law still affords compensation for injury and fraud sustained in consequence of adulteration, but unfortunately very inadequate, because expensive and troublesome to obtain, and moreover uncertain.

We cannot conclude without a remark on the analyst selected. In this instance no better appointment could have been made than that of the medical officer to the City. Few chemists have had so much practice in the detection of adulterations as Dr. LETHEBY. He took a leading part in the analytical sanitary commission of the *Lancet*, whose discoveries led directly to the passing of the Act, and he is properly rewarded by an appointment under the Act. It has been generally supposed, however, that most of the posts would be filled by the medical officers for the districts, but this we conceive would be a great mistake. Beyond three or four gentleman in the metropolitan districts, who are eminently qualified for the appointments, it is no disrespect to the majority, in the absence of further evidence to the contrary, to say that the posts would be much better filled by those who have devoted themselves exclusively to chemical pursuits. The simplest analysis is after all not an easy task to unpractised hands, and the detection of some adulterations requires no ordinary analytical skill.

As to the salaries it ought to be at once understood that the highest fee receivable under the Act is a very insufficient remuneration for more than the most cursory examination of a substance; and the amount of fees received would therefore be but a small reward for the labour and skill devoted in honestly carrying out the purposes of the Act.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Notes on some of the Chemical Reactions of Corrosive Sublimate, by T. G. WORMLEY, *M.D.*

(*Concluded from page* 182.)

XI. Copper Test.—This test consists in introducing into the corrosive sublimate solution a small slip of clean copper foil, which will cause a decomposition of the mercury compound, with the deposition of metallic mercury upon the copper. The delicacy of the test is much improved by acidulating the mercury solution with hydrochloric acid, and also by heating the acidulated solution. In the following experiments a grain measure of the mercury solution was placed in a watch glass, and acidified with hydrochloric acid; the slip of copper being introduced into the solution, it was heated over a small flame of a spirit lamp.

1. $\frac{1}{100}$th, grain of corrosive sublimate will impart to the copper an immediate silvery lustre, which soon becomes grey, and then dark grey; this reaction takes place equally well without the hydrochloric acid, or heat. The copper should not be less than about $\frac{1}{2} \times \frac{1}{2}$ inch, otherwise some of the mercury will become detached. After allowing the copper to remain in the solution for several minutes, it is to be removed and carefully washed with a small stream of water from a wash-bottle, or with water containing a little ammonia; it is then gently pressed between folds of filtering paper until perfectly dry. It is now placed in a small and perfectly clean and dry reduction tube; heat being applied to the closed end, the mercury will volatilise and condense a little distance above the point heated, in the form of a mist-like deposit, very readily discernible by the naked eye. If the sublimate be examined with a low power of the microscope, it will be seen to consist of innumerable spherical globules, which are opaque by transmitted light, and present a very bright silvery lustre under inci-

dent light. The tube should only be heated in the part which contains the copper; every time the mercury is volatilised it is attended with more or less loss.

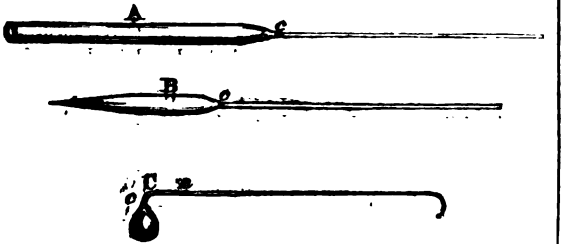
2. $\frac{1}{10000}$th, the copper immediately presents a silvery appearance, and in a little time becomes grey. This takes place about equally well without heat. Without either acid or heat, the deposit begins in a very little time; by heat alone, immediately. The copper when heated in a reduction tube gives a sublimate very perceptible to the naked eye.

3. $\frac{1}{100000}$th, when acidified and heated with a slip of copper of about $\frac{1}{10} \times \frac{1}{30}$ inch, the deposit is immediately perceptible, and very soon very satisfactory. Without either acid or heat the deposit takes place very slowly. If the copper be heated in a narrow tube, it gives a sublimate quite perceptible to the eye.

When deposits much smaller than the last given, are heated in an ordinary reduction tube the results are not uniform; depending upon the fact that the sublimate forms very small globules, which are distributed over a large space, and part of it seems to entirely escape condensation within the tube.

Very uniform results may be obtained by taking a small clean tube of about $\frac{1}{10}$ inch in diameter, and drawing it out into a fine capillary point of from $\frac{1}{30}$ to $\frac{1}{50}$ inch in thickness. An exact impression of the tube used in the following experiment is given in the accompanying plate, fig. 4.

The copper is introduced through the wider portion of the tube to the point *c*, and then heat applied to the outer end, and slowly brought to within a little distance of the copper; when the tube is soft it is drawn off as shown in fig. B. At the same time a second reduction tube can be formed. The neck of the tube is now moistened with water, or wrapped with wet cotton, and then the blowpipe flame applied to the closed extremity, which is slowly fused into a bead, until the heat arrives at the copper, as shown in fig. c. The capillary end may now be fused shut. When wiped and examined with the microscope, the mercury deposit will be found at about the point *m*, forming a very narrow ring of well defined globules. These tubes may be reserved for future examination.



4. $\frac{1}{50000}$th, the acidulated solution may be heated several times in the watch glass, and as the fluid evaporates its place should be supplied with water. Care must be taken that the copper does not become dry. In a very little time the copper will present a silvery appearance, which soon changes to a very decided and satisfactory grey deposit. When heated in a tube it yields a sublimate perceptible to the eye, and which when examined with an amplification of about 75 diameters will be found to consist of a ring of well defined globules. In a number of cases over 100 globules, varying in size from $\frac{1}{1000}$ to $\frac{1}{10000}$ inch were counted, many of them being about $\frac{1}{3333}$ inch in diameter.

5. $\frac{1}{500000}$th, treated as stated in 4, the copper being $\frac{1}{30} \times \frac{1}{30}$ inch, will after some time impart a quite distinct lustre to the copper, which, when heated in a tube, will present, under the microscope, a fine sublimate of globules much like 4.

6. $\frac{1}{1000000}$th, the copper receives a decided metallic lustre or tint; when heated in a tube it always gives a very satisfactory result. In some few cases over 100 globules were perceived, several of which measured $\frac{1}{1500}$ inch, the greater number, however, were quite small. None less than $\frac{1}{10000}$ inch were counted. In a majority of cases about fifty well defined and satisfactory globules were counted, the most of which were in the field of a $\frac{1}{4}$ inch objective. So far as the evidence of mercury is concerned, this quantity of corrosive sublimate will furnish just as satisfactory results as $\frac{1}{1000}$ grain, the only difference being in quantity.

7. $\frac{1}{10000000}$th, the copper shows but a slight change. When heated in a tube as many as twenty pretty good sized globules were counted, the largest of which measured $\frac{1}{3000}$ inch, the most of them, however, varied from $\frac{1}{5000}$ to $\frac{1}{10000}$ inch. In a majority of cases only from five to ten globules measuring more than $\frac{1}{5000}$ inch were obtained. In this and the previous case many small points were observed, but they were too small to decide upon with certainty; in no case was any counted measuring less than $\frac{1}{10000}$ inch.

Amplification will assist somewhat in the determination of the mercury globules, but not so much as might be expected. When an amplification of 75 is used, a globule measuring $\frac{1}{3000}$ inch is perfectly satisfactory, such a globule, if a perfect sphere, would weigh $\frac{1}{180000000}$ grain, when of $\frac{1}{5000}$ inch, they are small but distinct and satisfaciory, such a globule would weigh $\frac{1}{600000000}$ grain. When of $\frac{1}{1000}$ inch, and associated with larger ones, they are still rather satisfactory; weight $\frac{1}{1000000000}$ grain. When of $\frac{1}{10000}$ inch they appear as mere opaque points, and are too small to be decided upon. When under an amplification of 250 or 300 a globule of $\frac{1}{1000}$ inch is very satisfactory; when of $\frac{1}{10000}$ inch it may be made out with considerable certainty, an amplification of 400 or 500 does not improve it much; such a globule would weigh $\frac{1}{1000000000}$ grain.

On account of the curvature and thickness of the glass tube, the higher powers of the microscope cannot be applied, a $\frac{1}{4}$ objective is about as high as can be used with satisfaction. When upon a flat surface, much smaller globules than any of the above can readily be seen; with a $\frac{1}{4}$ objective an "artificial star" measuring only $\frac{1}{15000}$ inch, will present the characters of sphericity and opacity, and will reflect incident light; but it must be remembered that foreign matter will sometimes present the same properties, or at least so much like the mercury globule as to make it unsafe to draw any decided conclusion. It would therefore seem that a globule less than $\frac{1}{5000}$ or $\frac{1}{10000}$ inch, could not be decided upon with certainty; the test, however, is so extremely delicate, that there is no need of torturing it even to this extreme.

It is not intended to imply that $\frac{1}{5000000000}$ grain of mercury can be *recovered* by this test, but only that that amount will give satisfactory evidence under the microscope when furnished by the test. The above experiments would seem to indicate that $\frac{1}{500000}$ grain of corrosive sublimate was about the least quantity that would furnish satisfactory evidence of the presence of mercury. There is a tendency on the part of some chemists to arrive at the conclusion that the amount of a substance that can be indicated by a test is the amount that can be recovered. This is a gross fallacy.

In the above cases it should be remembered that the

amount of mercury present in the corrosive sublimate was as 100 is to 135·5. Therefore $\frac{1}{500000}$ grain of corrosive sublimate would represent only $\frac{1}{675000}$ grain of metallic mercury.

Most tests are dependent in their reaction, not upon the absolute quantity of a substance present, but upon the degree of dilution. In the copper test for mercury, however, it is a mater of absolute quantity more than degree of dilution: for 1,10 grains of a $\frac{1}{100000}$ solution of corrosive sublimate gives nearly as good reactions as 1 grain of a $\frac{1}{100000}$ solution; 2,10 grains of a $\frac{1}{500000}$ solution, nearly the same as 1 grain of a $\frac{1}{50000}$ solution. It, however, requires a longer time for the deposition to take place.

The smallest visible quantity of corrosive sublimate when mixed with a small quantity of well calcined carbonate of soda, and heated in a small reduction tube, will give a copious sublimate of mercury globules.

XII. Extraction of Corrosive Sublimate from Water by Chloroform and Ether.—1. If 1 grain of corrosive sublimate be dissolved in 100 grains of water, and then agitated for several minutes with an equal volume of chloroform, the chloroform will extract about ·04 grains of the mercury compound.

2. Ether, under the same circumstances, will extract ·67 grains of the corrosive sublimate.

Columbus, Ohio, 1860.

On the Coloured Derivatives of Aniline, by M. E. Wilm.[1]

The present communication is intended to give some information relative to the composition and constitution of the aniline violet now so extensively used in the arts. Nothing will be said of the mode of application, since it is well known that this, as well as the other coloured derivatives, combines directly with wool and silk, but in the case of cotton requires the mediation of some organic mordant such as albumen.

The specimen of violet aniline or *anileine* I have analysed was prepared by M. Kœchlin of Mulhouse, who placed it at my disposal. It had been brought to a tolerable degree of purity, but nevertheless contained some resinous and mineral matters. These were removed by dissolving it first in weak alcohol, and then repeatedly in absolute alcohol. After this treatment it left no residue on incineration.

The following are the figures obtained in four analyses:—

I. 0·2497 grm. gave 0·695 carbonic acid, and 0·1355 of water
II. 0·2695 „ 0·734 „ 0·140 „
III. 0·311 „ 0·850 „ 0·164 „
IV. 0·3575 „ after combustion with soda-lime gave 0·351 of platinum.

The percentage composition, calculated from the above results, is as follows:—

	I.	II.	III.	IV.	Mean.
Carbon	74·87	74·29	74·54	...	74·56
Hydrogen	5·94	5·77	5·86	...	5·86
Nitrogen	...	...	...	13·90	13·90
Oxygen	...	...	...	...	5·68

These numbers answer with sufficient exactness to the formula

$$C_{18}H_{17}N_3O$$

which requires the following numbers:—

Carbon	74·23
Hydrogen	5·86
Nitrogen	14·41
Oxygen	5·50

[1] *Répert. de Chim. pure et appliqué*, p. 204, Sept. 1860.

The body therefore will be the result of the action of 3 atoms (double) of oxygen on 3 molecules of aniline, with the elimination of 2 molecules of water, according to to the equation

$$3(C_6H_7N) + 3O = 2H_2O + C_{18}H_{17}N_3O.$$

The above experiments were made with two distinct products prepared by the same process. It remains to be seen whether products prepared by different processes would yield the same results. M. Scheurer Kestner, who has repeated my analyses, has found amounts of carbon and hydrogen agreeing exactly with my own, but he has found a smaller proportion of nitrogen. I do not know whether his preparation is the same as that of M. Kœchlin.

Aniline violet, when pure and dry, is of a beautiful green colour, a good deal resembling murexide. It gives an intense colour to water, although its solubility in that menstruum is very small. A very small quantity of carbonate of soda and some other salts precipitate it entirely from its solution. The best solvents for anileine are alcohol, acetic acid, and glycerine. It is a very stable body, reducing agents having no action upon it. Oxidising agents modify it; but if the action has not been very energetic, the colour reappears on the addition of sulphite of soda. When an acetic solution is treated with binoxide of lead, anileine is destroyed, and a red solution is obtained, which perhaps contains rosolic acid, C_6H_6O.

The characteristic reaction of anileine is its turning blue with concentrated hydrochloric and sulphuric acids; on the addition of a certain quantity of water, however, the violet colour is reproduced. This test serves to distinguish it from the violet of archil, which, under the same circumstances, changes to red.

When hydrochlorate of aniline is treated with a small quantity of chlorate of potash a green precipitate is produced, which remains suspended in a brown liquor. If the action be stopped when the precipitate is formed, the filtered liquor has one remarkable property:—when a fabric or sheet of paper is impregnated with the liquor, and exposed to the action of the air at 40° or 50°, it soon takes a beautiful deep green shade. In this we have a phenomenon quite analogous to that of the oxidation of white indigo, only the action of the air is slower. By continuing the action of the chlorate of potash longer, the violet of aniline is produced, and at last chloranile or perchlorated quinone.

When aniline is treated with chlorine, the violet is also obtained, but the production is not immediate; the aniline first becomes of an intense blue, and if the operation be conducted in the presence of air, the part of the liquid exposed to the action of oxygen is coloured a deep green—a similar phenomenon to that quoted above.

I shall conclude with a few words on the red derivatives of aniline, fuchsine, and azaleine. The history of these bodies is very obscure: the first is produced by the action of anhydrous metallic chlorides on aniline; the second under the influence of nitrates, and also of nitric acid. It is clear that fuchsine cannot contain oxygen; it is no doubt a particular base combined with hydrochloric acid, for all the chlorine it contains is precipitable by nitrate of silver.

The following are some determinations of the carbon and hydrogen:—

	I.	II.	III.	IV.	V.
Carbon	69·63	69·54	69·16	66·84	60·00
Hydrogen	5·86	6·72	6·01	5·99	5·75

From such results it is impossible to draw any conclusion relative to the composition of fuchsine. The amount

of chlorine is 9·50 per cent. when the determination has been made with lime or directly with nitrate of silver.

The nitrogen cannot be accurately estimated by a combustion with soda-lime, for a certain quantity of aniline is always obtained, which forms a stable chloroplatinate. The amount of this element is about 10 per cent. but the results are always very discordant. The azaleine prepared by M. Gerber of Mulhouse differs from fuchsine, first in the mode of preparation, and then in not containing chlorine, but nitric acid. It is very probable that these two bodies are the chloride and nitrate of the same base.

Separation of the Oxide of Lanthanum from the Oxides of Cerium and Didymium, by M. Statt.[1]

The oxide of lanthanum may be separated from the oxides of cerium and didymium in the following manner: The oxides, precipitated and washed, are dissolved in nitric acid in a platinum crucible, and the solution is evaporated to a syrupy consistence. Some saturated solution of chlorate of potash is now added, and afterwards an amount of caustic potash equal to the weight of the chlorate. The mixture is then dried with a gentle heat (constantly stirring with a platinum spatula) and afterwards lightly calcined. On the addition of water the cooled mass is partially dissolved; but in time there deposits from the solution, either on boiling or at the ordinary temperature, a yellowish white powder, and the liquor no longer contains a trace of the oxides of the metals from cerite. The precipitate united to the residue insoluble in water is now washed with boiling water, dried at 150°, and then digested at a gentle heat with nitric acid diluted with 10 times its volume of water. After a day the acid is decanted and renewed. The nitric liquors united and concentrated have a yellow colour. They are precipitated with ammonia and carbonate of ammonia; the precipitate is redissolved in nitric acid, precipitated again, dried, calcined, and weighed. We thus obtain the weight of the oxide of lanthanum.

The residue, after the treatment by nitric acid, is dried at 150°; it resembles the precipitate of sesquioxide of iron. It is ignited in an atmosphere of hydrogen and then weighed, the weight represents that of the protoxides of cerium and didymium.

TECHNICAL CHEMISTRY.

On the Preparation of Artificial Colouring Matters with the Products extracted from Coal Tar, by M. E. Kopp.

(*Continued from page 174.*)

Preparation of Nitro-benzole.—The preparation of nitro-benzole is accomplished, on the large scale, by allowing a fine stream of benzole, and another of the strongest nitric acid to run together in a worm or long glass tube kept well cooled. The two liquids react on each other on coming in contact, heat is disengaged, and nitro-benzole is formed. Commercial nitric acid mixed with half its volume of sulphuric acid may be substituted for the concentrated nitric acid. The nitro-benzole collected at the end of the worm, is first washed with water, then with a solution of carbonate of soda, and afterwards once again with water.

Nitro-benzole is a yellowish liquid which at 15° C. has the sp. gr. 1·209[2]. It boils at 213°, and cooled to 3° it crystallises in needles. Having an odour closely resembling that of the essential oil of bitter almonds, it has been largely used in perfumery for scenting fancy soaps, for which purpose it has one advantage over the oil of bitter almonds—it is less affected by the action of alkalies. It is almost insoluble in water, but is very soluble in alcohol, ether, and the essential oils. Concentrated nitric and sulphuric acid dissolve it, but it is precipitated on the addition of water. It is decomposed by continued boiling with concentrated sulphuric acid; and under the same circumstances with concentrated nitric acid it forms bi-nitro-benzole. Neither the alkalies in strong aqueous solution, nor quick lime act on nitro-benzole; but an alcoholic solution of the alkalies act energetically and form azoxybenzole ($C_{24}H_{10}N_2O_2$). By the action of nitric acid on this last substance a number of other interesting bodies are produced, which, however, it is not necessary now to describe.

Transformation of Nitro-benzole into Aniline. This is effected by a variety of processes which we shall proceed to describe in detail.

1. *By means of sulphide of ammonium.* An alcoholic solution of nitro-benzole after having been saturated with ammoniacal gas is treated with a current of sulphuretted hydrogen. The liquor now becomes of a deep dirty green colour, and deposits a little sulphur. It is now left for twenty-four hours, during which time crystals of sulphur are deposited, the odour of sulphuretted hydrogen disappears, and is replaced by a strongly ammoniacal smell. If distilled now to recover the alcohol, a good deal of sulphur is deposited, and it is impossible to continue the distillation long, because of the violent bumping which ensues. It is therefore allowed to cool and the sulphur is removed. On distilling the liquor again more sulphur is deposited, which must also be removed. The process must be continued, re-saturating the liquor with sulphuretted hydrogen if need be, until a heavy oily matter (aniline) deposits, which must be separated from the liquor and re-distilled by itself. The aniline is thus obtained nearly pure.

Instead of using an alcoholic solution of nitro-benzole, and treating it successively with ammonia and sulphuretted hydrogen the alcoholic solution of sulphide of ammonium may be prepared beforehand, and the nitro-benzole poured into it. A part is dissolved immediately, and the remainder by dryness in the course of the operation. It is sometimes advantageous, instead of waiting until the aniline separates, to add hydrochloric acid to the liquor in the retort until it is slightly acid, and then to distil almost to dryness, by which means chloride of aniline is obtained. This is decomposed by an excess of caustic soda, and the aniline set at liberty is distilled off.

To avoid any danger from the bumping a tinned copper still must be used, which should be heated by steam under a light pressure. At first the temperature should not exceed 90° C. but after some time it may be raised to 100° or 110°.

The ammoniacal alcohol condensed in the worm may be re-saturated with sulphuretted hydrogen, and used over again with a new quantity of the nitro-benzole.

2. *Reduction of the nitro-benzole by nascent hydrogen.* In preparing aniline by this process the nitro-benzole and zinc are placed in a vessel and dilute sulphuric or hydrochloric acid is added so as to produce the disengagement of a small quantity of hydrogen. By degrees the nitro-benzole disappears and aniline is formed, which remains in solution in the hydrochloric or sulphuric acid. To isolate it an excess of caustic soda is added and the mixture is distilled, on which the aniline passes over with the vapour of water.

[1] *Jour. für prakt. Chem.* Bd. lxxix. s. 257.

[2] Stated erroneously by M. Parisel, Chem. News vol. ii. p. 96, to be 1·080.

Bechamp first recommended the employment of acetic acid and iron filings. He places in a retort one part of nitro-benzole, one and a half parts of iron filings, and one part of concentrated acetic acid. The reaction takes place without the application of external heat, the mixture becoming hot by itself, and the vapour being condensed in a receiver, which must be kept well cooled. The condensed products consist of aniline, acetate of aniline, and some unchanged nitro-benzole. These are allowed to cool and are then returned to the retort and again distilled to dryness. The distillate is now treated with potassa fusa, and the aniline separates as an oily layer, which must be removed and distilled once more.

The residue of the mixture of iron filings, acetic acid and nitro-benzole, which remains in the retort after the distillation, still contains a considerable amount of aniline. To obtain this the retort must be washed out with water acidulated with sulphuric or hydrochloric acid and the solution filtered, and then evaporated to dryness. The dry residue is then mixed with quick lime, and placed in a retort of iron or refractory ware and distilled; and the aniline thus obtained must be rectified.

PHARMACY, TOXICOLOGY, &c.

On the Detection of Strychnine and other Vegetable and Animal Proximate Principles, by Thos. E. Jenkins.

The writer having been employed in the month of September 1855, to investigate, chemically, a case of suspected poisoning, a course of analysis was entered into, the result of which indicated the presence of strychnine in the contents of the stomach.

One set of reactions which pointed to this poison, was the coloration produced by oxidising agents; these reagents, although said by many chemists to be characteristic tests for strychnine, were not certainly known to be so by me, for the simple reason that I had not tried and seen their effects upon the various organic principles which were accessible to me. To satisfy myself upon this point, the following experiments were made.

It was not deemed necessary to use more than one of the oxidising agents commonly employed for the purpose, because the results produced are substantially the same whether the oxidation be produced by one or the other of them.

The manner of making these experiments was simply to mix on a white porcelain surface about the twentieth of a grain of the organic substance with one or two drops of colourless *concentrated sulphuric acid*, allowing them to remain in contact for a few moments, then testing with a small fragment of a crystal of *bichromate of potassa* drawn through the solution or mixture.

With many of the principles the sulphuric acid reacted powerfully with the development of beautiful and, in several instances, intense colours. These I have noticed, as well as those produced by the subsequent action of the bichromate of potassa.

In these experiments I have disregarded all changes except those resulting in the production of colours or their mutations.

In point of time, quantity of substance tested, and mode of operating, the experiments were all as nearly alike as possible.

The proximate principles which I employed were pure and nearly all in crystals.

The changes in colour are given in the order in which they occurred.

Proximate Principles.	Colour Produced by Sulphuric Acid.	Colour Produced by Bichromate of Potassa.
Morphine,		Brown, green.
Narcotine,	Canary yellow,	Bwn. dirty green, blue
Ononine,	Light orange,	Bwn. dirty green, blue
Papaverine,	Purplish red,	Greenish yel. dk green
Peucedanine,	Lemon yellow	Dirty yellow
Phloridzine,	(evanescent)	Yellow, green, bluish
Picrotoxine,	Orange yellow,	Yellow, green
Rheine,	Intense red,	Muddy, green.
Piperine,	Bromish red,	Dirty, green.
Salicine,	Rose red,	Brown, quickly green.
Santonine,		Yellow
Strychnine,		Blue,purple,red,orange
Theine,		Slight brown yellow
Theobromine,		Slight brown yellow
Caffeine,		Light yel. green, brown
Urea,		Yellow, no change.
Veratrine,	Intense brown red,	Brownish yellow,green
Aconitine,	Brown,	Brownish green, bluish
Anemonine,		Yellow
Asarine,	Brownish red,	Brown, dirty green
Atropine,		Yellow
Cantharadine,		Yellow
Codeine,		Green
Delphinine[1],		Orange, broom, green?
Columbine,	Brownish yellow,	Brown
Daturine,	Yellow,	Evanescent pink, green
Digitaline,	Brown,	Yellow, green
Elaterine,	Brown,	Brownish, yellow
Emetine,	Brown,	Muddy yellow, green
Gentianine,	Yellow,	Yellow
Meconine,	Yellow,	Yellow, green
Sanguinarine,	Red,	Brown
Solanine,	Orange,	Yellow, green
Cinchonine,		Light, green
Quinine,		Light, green
Quinidine,		Green
Bebeerine,	Brown,	Brown, green
Esculine,		Brown, dark green.
Amygdaline,	Rose red,	Brown, light grn. blue
Berberine,	Brownish yellow,	Deep red, brown
Brucine,		Bright,brick red,green, yellow
Cetrarine,	Brownish yellow,	Brownish yel. green.
Cubebine,	Beautiful red, [red,	Yellowish green
Hæmatoxyline,	Orange, dark brown,	Dark, brown
Indigotine,	Dark greenish blue,	Orange
Kinovic Acid,	Yellow,	Pink, green.
Kinic „		Green
Gallic „		Green
Carbazotic „		Brown
Uric „		Yellowish, green

Nearly all left a green coloration on the spot after the lapse of twenty-four or forty-eight hours, owing to the reduction of chromic acid to sesquioxide of chrome.

These and other observations I have made in regard to vegetable proximate principles, convince me of their general and powerful deoxidising properties, as well as the establishment of the fact that the "*colour test*," or "*oxidising test*," is not only delicate but characteristic, and consequently reliable. In reference to the delicacy of the "*colour test*," I found that when one grain of pure strychnine was dissolved in 400,000 drops of distilled water, and one drop of that solution was allowed to evaporate to dryness on a glass plate, not only were the crystals of strychnine revealed by the microscope, but on the addition of a small drop of very white concentrated sulphuric acid, and the subsequent application of the point of a spicula of bichromate of potassa, the characteristic colours were brought out.

[1] The result of one experiment.

Articles of Food and Drink.	Substances with whe	
	Class I.	Class II.
Acids:—Acetic, Vinegar	Wood spirit, tarry matters, &c.	
" Citric, "Lemon-juice" "Lime-juice," &c.	*Microscopic fungi* and *decaying organic matter*	
" Tartaric, "Effervescing-powders," drinks, &c.		
Beer:—Ale, "Scotch," and other sweet varieties	*Results of imperfect manufacture.*	
" " "Bitter," "India," &c.	——	
" Porter and Stout	——	
Biscuits:—(See also *Flour, Bread, Butter, Sugar*, &c.)	*Micro. fungi, animalcules, lactic acid*, &c.	
Bread:—Ordinary	*Fungi*, &c. *lactic acid.*	
" "Fancy" (See also *Butter, Sugar*, &c.)	——	
Butter:—Fresh "Devonshire," "Epping," &c.	*Butter-milk, curd, butyric and lact. acid.*	
" Salt "Dorset," &c.	——	
Cheese	*Fungi, animal. lact. and valerian. acids*, &c.	
Chicory	Results of over roasting.	Ordin. dandelion roots, by error.
Chocolate	Results of over heating, imperfect fermentation, &c.	*Inferior nuts, unripe, old or germinating specimens.*
Cocoa		
Coffee	Impaired quality from over roasting.	(When green) damaged berries, &c.
Condiments and Spices:—Allspice, &c. (powder)	Results of improper preparation, packing, or of exposure to atmospheric influences, or fermentation, dust, &c.	Shrivelled corollas, twigs, &c.
" " Cloves		Undeveloped and old roots.
" " Ginger		Injured and undeveloped fruit, &c.
" " Mace and Nutmegs		——
" " Mustard		——
" " Pepper		——
" " " Cayenne		
" " Vanilla	Results of improper drying, &c.	Unripe and damaged pods.
Eggs	Results of packing in lime, damp straw, &c.	*Addled and rotten eggs.*
Farinaceous foods:—Arrowroot	Cellulose, &c. from insuf. washing, &c.	
" Flour	*Dust, sand, (from millstones) bran*, &c.	*Results of diseased grain (g)*
" " Barley, Oatmeal, &c.	——	
" Millet	Dust, husks, &c.	Seeds of other *graminacea.*
" Peas, Beans, Lentils, &c.	——	Damaged specimens, &c.
" Sago, Tapioca, &c.	Results of over heating, &c.	
" Wheat (grain)	Husks, dust, shrivelled and inf. grains, &c.	*Shatted and mildewed grains*, &c. (*h*)
Fish (fresh)	Results of improper packing, &c.	*Partly decomposed specimens.*
" (preserved) Anchovies	*Results of improper preparation*, &c.	——
" " Sardines and other varieties	Decomposition from *rancid oil*, &c.	
Fruit (fresh) large varieties Apples, Pears, Oranges, Melons	*Results of improper packing, handling, or collecting.*	*Undeveloped or decaying specimens*, se rious insects, *fungi, dust*, &c.
" " small varieties, Strawberries, Currants, &c.		
" (preserved) Jams, Jellies, &c.	*Products of ferm.* &c. fr. use of *damp fruit*, unclarified sugar, imperf. prep. &c.	
" " Marmalade		
" " Various dried kinds	*Results of imperfect preparation*, &c.	
Gelatine:—Isinglass	*Fungoid growths* from being stored when damp, &c.	
" Gelatine		
Liqueurs:—Curaçoa	Decomposed syrup from over heating, &c.	
" (various)	*Products of fermentation.*	
Meat (various)	*Products of decomposition*, &c	*Results of organic disease*, &c.
" Pork, &c	——	*Entozoa*, &c. PECULIAR POISON, &c. (*j*)
" Tongue (ox)	Imperfect curing.	
" Various cooked and preserved varieties	Congestion from method of killing, preparing, &c.	
" Poultry, Game, &c.	*Results of bad feeding*, &c.	*Results of various diseases.*
Milk	*Results of damp, time*, &c.	*Taken at wrong periods.*
Nuts (various)	*Fungoid growths*, &c. *from exposure to air.*	*Unripe or decayed specimens*, &c.
Oils:—Olive, Florence, Lucca, &c.		Colouring matter, &c.
Pickles:—"Mixed," "Piccalilly," &c. (See also *Vegetables, Condiments, and Vinegar*)	(See Vinegar, &c.)	
Spirits:—Brandy	*Fusel-oil, wood spirit*, &c.	
" Gin	*Fusel oil*, &c.	
" Other varieties	——Acetic, *butyric, valerianic acids*, &c.	
Sugars:—Loaf	Native colouring matter, &c.	
" Brown	—— *Various insects, fungi*, &c. molasses.	
" Honey	*Dust, products of fermentation*, &c.	Wax, peculiar flavouring principles, &c.
Sugarplums (various articles of confectionary)	*Results of imperfect manipulation.*	
Tea:—Black	Old and over dried leaves from defective manipulation.	Old and inferior leaves, twigs, &c.
" Green		Old and inferior leaves, &c.
Vegetables:—Fresh ordinary varieties	*Diseased and blighted specimens, undeveloped and decaying specimens. Dust, insects*, &c.	*Decaying or unseasonable.*
" " Horseradish		ROOT OF ACONITUM NAPELLUS (*q*)
" " Parsley		ÆTHUSA CYNAPIUM (*q*).
" " Watercresses		HELOSCIADUM NODIFLORUM (*q*).
" " Mushrooms		*Var. species of poison. fungi*, &c. (*q*)
" Dried or preserved varieties (See *Pickles and Sugarplums*)	*Results of imperfect manipulation.*	
Wines:—British, Ginger, Raspberry, &c.	—— *Veg. acids, fungi*, &c.	
" Foreign, Port, Claret, &c.	Results of *Oidium*, tartar, &c.	
" " Sherry, Madeira, &c.	Results of *Oidium*, &c. in the vine.	
" " Champagne and allied wines	——	
" Allied beverages—Cider, Perry, &c.	*Results of bad fruit, imperf. manip.* &c.	

Note.—In the above Table the names of adulterants more or less injurious to health are printed in *italics*, poisonous

BY ARE ADULTERATED.

CLASS III.	CLASS IV.	CLASS V.	CLASS VI.	REMARKS.
Water.	*Sulphuric acid*, brown sugar, &c. (*a*)			*a* Rarely with oxalic acid, probably from leaves of *oxalis acetosella*.
Water.	Tartaric acid, *tartar*, sugar, &c. (*b*)			*b* Some "*citronade diferienne*" examined by me contained *no citric acid at all!* Lemonade is *said* to be sometimes adulterated with mineral acids.
Water, white sugar.	*Tartar.*			
Water, sugar.	Sugar, *chamomile flowers*, salt, &c.			
Water, sugar.	COCCULUS INDICUS, NUX VOMICA, QUASSIA, &c. (*c*)			Some kinds of gum may be added to Scotch ale to give richness.
Water.	——*Sulph. acid*, liquorice, br. sugar, *logwood*, salt, &c.			*c* Also THORNAPPLE, *wormwood, bitter ash wood*, "*grains of paradise*," *salicine*, and even pure STRYCHNINE. Hops are liable to the attacks of a peculiar fungus, *erysiphe macularis*, and are adulterated with old and spent hops and sweet flag.
Sat. *bad flour*, starches, *bone dust*, &c.	Salt, *alum*, various starches, &c.			
Sat. *bad flour, bone dust*, potatoes, &c.	Potato and other starches, *alum*, salt, *borax*, &c.			
——*Chalk, plaster of Paris*, &c.	——Carb. ammonia, gum, &c.	*Various colouring matters*, &c. such as saffron; CHR. YEL. &c.		
Water, lard, mutton fat, starch, &c.	Fats, annatto, *saffron, nitre*, &c.			*d* Some time ago butter was adulterated with *soluble glass* at certain large provincial towns.
——Salt, nitre, SILIC. OF SODA (*d*).	——			
Inferior varieties.	Annatto.			*e* I have not met with or heard of any chicory containing clays or mineral colours.
Brickdust, oatmeal, dandelion, &c. (*e*).	Coffee-grounds, br. sugar, salt, &c.			
Bricked. starches, oatmeal, linseed, *Red clays, sawdust, tallow*, &c.	Var. fats, RED LEAD, *Venetian red*; *red ochres, clays*, sugar; salt; &c.			*f* Acorns, parsnips, &c. roasted, are occasionally added.
Roasted corn, *beans, sawd.* star. &c. (*f*)	Burnt sugar.			
Bricked. sed. & oth. woods & *sweepings*.	Inferior spices, essences, &c.			
Spent cloves, myrtle-buds *, &c.	Burnt sugar; oil of cloves, &c.			
Flour, *chalk, plaster of Paris*, &c.	Cayenne pepper, &c.		Sp. clo. & im. do.	*g* The addition of myrtle-buds is doubtful (in my opinion).
Betel nuts, damaged samples, &c.	Oil of nutmegs.		Imitation ginger.	
Hay, flours, radish-seed, oatmeal, &c.	*Turmeric, gamb.* annatto, *Cay. pep.* &c.		Betel-nuts, wood-eh nutmegs, &c.	*g* Corn is often injured by the *uredo frumenti* and other fungi, also by insects such as the *musca pumilionis*, &c.
Bricked. boned. slate, flours, star. &c.	Capsicums, long pepper, lime, &c.			
Bricked. clay, oatm. *red wood chips*, &c.	Long pepper, &c.			
Water, damaged and spent pods.	Treacle; essences, benzoin, &c.		Other bean-pods.	* Doubtful. Some "best Bermuda arrowroot" in my possession exhibits, under the microscope, when moistened with dist. water, some living animalcules about one-eighth of the size of the starch granules.
Inferior and boiled eggs.			White eggs coloured like the rarer kinds (?)	
Potato, rice, & oth. star. sago-meal, &c.	Dextrine.*			
Bad flour, starches, *plast. of Paris*, &c.	Salt, *alum.*			*h* Sometimes poisonous.
Dust, sweepings, starch, sawdust.	Salt, sugar.			
Other seeds, husks, sand, &c.				
Damaged, inf. kinds, horsebeans, &c.	Gum, dextrine.			
Inferior and damaged varieties.	——			
See 1st and 2nd Classes. Water, &c.	Steam (to swell the grains).			
Inferior varieties.	Salt, *chloride of lime*, &c.			
Sprats and other inferior varieties.	RED LEAD, *bole, Venetian red*, &c.		Sprats. & oth. fish.	A common adulteration, or rather substitution.
——	——		——	
Washed, boiled, and false specimens.	*Alkaline and acid washes.**			* (Doubtful).
Inferior kinds, *wild fruits, berries*, &c.	*Solution of tartaric acid.*			*i* Generally organic, and not often *very* injurious.
Starch, gelatine, gum, &c.	*Various essences, colours*, &c.			
Starch, &c. ord. oranges, turnips, &c.	*Gamboge, salicine, and various bitters.*			
Inferior and damaged varieties.	*Various essences and colours.*	*Various colouring matters.* (*i*)		*j* Far more common in Germany and parts of Switzerland than in this country, although specimens of German sausage, &c. affected with it are occasionally met with here, even when of British manufacture.
Gelatine of various qualities.	Isinglass (externally applied).	*Various colouring matters.* (*j*)	Gelatine. Glue.	
Glue, gelatinised paper, &c.				
Water, syrup, molasses.	Sugar, *capsicums, pepper.*			
Water, gin, &c.	Sugar, salt, *nitro-benzole, var. ess.* &c.			
Inferior portions of animal.	Salt, ARSENIC, *chlorids of lime*, &c.			
——	——			*k* Solutions of arsenious acid, or arsenite of potassium, are constantly employed by poulterers and others for washing over poultry, game, &c. with the view of keeping them (superficially) fresh. The practice is a dangerous one, and cannot be too strongly reprehended.
Old and diseased specimens.	Nitre, salt, &c.		Horses and cows' tongues.	
Diseased and inferior portions.	Pepper, salt, and various spices.			
Damaged and inferior varieties, &c.	——(When dres.) ARSENIC, &c. (*k*)			
Water, *butter-milk*, skim-milk.	Annatto, *cerebral matter, chalk*, &c.			
Damaged and inferior varieties.				
Various animal oils, &c.				
Inferior vegetables, spices, &c.	VERDIGRIS, COPPERAS (*l*) capsic. &c.	Var. green colouring matters.		*l* BLUE-STONE (sulphate of copper) is sometimes added to pickles to improve their colour; sometimes metallic copper is dropped in.
Water, gin, &c.	Pepper, capsicums, molasses, salt, &c.			
Water.	——SULPHURIC ACID, *turpentine*, &c.			
Water, inferior varieties, &c.	——*Various flavours*, &c.			
Chalk *, clay *, beet-root-sugar, (*m*) &c.		SCHEELE'S GR. VERD. *gumb.* VERMIL. CHR. YEL. and GR. and other cols. poison. or inju. *Var. ess. mirbane*, OIL OF ALMONDS, fus. oil, ess. &c. and various narcotics. (*p*)		
——*Sand*, salt, starches, &c.	Spicules, &c. of mica (?)		Carrara marble.*	* Doubtful, no *authenticated* instance has come to my knowledge.
Water, flour, potato-starch, &c.	Sugar various kinds, &c.			*m* Beet root sugar is probably derived from abroad.
Chalk, plast. Paris (*n*) *clay*, flo. star. &c.	Dextrine, molasses, &c.			
"*Lie tea*," leaves of *ash, beech, buckthorn*, oak, pop. *sloe*, willow, &c. (*o*).	*Black-lead*, lamp-bl. salt, *Prus. bl.* &c.			*n* *Universally* in the icing of twelfth and other cakes.
Old and damaged specimens.	*Salts of iron*, COP. & LEAD, *turm.* &c.			
——	Salt, carbonate of soda, &c.			*o* Tea is also (exceptionally) adulterated with logwood, rice in husks, spent tea re-dried, *felspar, soapstone*, and with various clays and colouring matters.
——			*Lie-tea* containing *no tea at all*, but made up of sweepings, &c. coloured.	
——				*p* ORPIMENT (sulphide of arsenic) is (rarely) found in confectionary, probably by being mistaken for some other yellow colour. In various *cough lozenges* narcotic poisons are often added with dangerous liberality.
Inferior varieties, water, &c.		*Various colours and essences.*		*q* Poisonous, generally mistaken for the true vegetables.
Water, *damaged preserves*, &c.	*Pepper, tart. acid, various flavours*, &c.			* Doubtful
Wat. cider, elder wine, *extr. of logw.* &c.	Brandy, *capsicums, catechu*, &c.			It is probable that *more than half* the "best champagne" is spurious.
Water, ginger-wine *, &c.	Brandy, *capsicums, var. essences*, &c.		*False champagne from gooseberries rhubarb*, &c.	
Water, cider, gooseberry-juice, &c.	Tartaric acid, bicarbonate of soda, &c.			
Water, *vinegar*, &c.	——			

Substances in small capitals. A dash rule —— in any column represents *all the substances* in the line immediately above it.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

LECTURE VI. *On the Decay and Preservation of Building Materials, by* D. T. ANSTED, *Esq. M.A. F.R.S.*

(*Continued from page* 189.)

The next group includes what we call limestones. Limestones differ more in their nature than sandstones do, and include different kinds of material. For example, there are the carbonates of lime pure and the carbonates of lime and magnesia. First of all, I will take the carbonates of lime. Some of these are perfectly crystalline, such as marble. Marble has a very close texture; it does not absorb water, and it is, therefore, little acted upon by it unless it contains acids. When sound it lasts a long time, but if cracked, decay will enter in where the crack occurs. Marble is a very expensive stone, and the quantity of it compared with the other kind of limestone is small, but there is a good deal of a sort of limestone intermediate between marble and common oolites. This is generally hard, and not unfrequently contains thin strings of foreign substances, as silica, which interfere with its working. Such stones are found in Derbyshire, and belong to what geologists call the carboniferous or mountain limestone series. They are crystalline, but irregular, being partially cracked and containing many fossils. A large majority of the limestones used in this country are oolites, so called because they appear to be made up of a number of eggs. These oolites are of various qualities. They are found in many parts of the country, and are commonly used for building, being, in fact, our common materials. There are several varieties of them which are of different value. One of the best is the Portland stone. There is a specimen upon the table, and a very good specimen it is. These stones are made up of a number of little particles, which are themselves groups of smaller particles. These little particles are cemented together by carbonate of lime, and the whole stone is nearly pure carbonate of lime. Portland is probably the best building stone we have in England, but is dear, being hard and expensive to work. St. Paul's Cathedral is built of Portland stone, and so is Greenwich Hospital, both being excellent examples. It is impossible, perhaps, to find better specimens of this stone than the Hospital. A few days before his death, I was with Sir Charles Barry at Greenwich Hospital, and he was pointing out to me the beautiful condition of the stone on the east face. It is, indeed, worth looking at as a specimen of the material, and is almost, if not quite, equal to the marble of which Milan Cathedral is built. There are many other good specimens of this stone in London, and of these the Reform Club is as good as any. If you look at these specimens of the better kind, you will hardly recognise the decay that takes place. You must look at stones which have been a long time exposed, or else at an inferior quality of material. Bath stones offer a wonderful contrast to Portland. Bath stone is almost as soft as cheese in the quarry, and it can then be cut with an ordinary knife. I speak now of the stones in the quarry, where all stones are softer and more easily worked than when they have been exposed for some time to the air. Bath stone, being exceedingly soft, is therefore cheap. It is easily got and easily cut, but it is not a stone that wears well. Some specimens of Bath stone are to be seen in the recent restorations of Westminster Abbey that have failed so completely as to be already a great deal worse than much of the stone that has been there for centuries. Within the few years that have elapsed since this stone was put up it has decayed entirely. And yet stones of the same kind, from nearly the same quarry—indeed some from the identical quarries—have been used in the city of Bath, and are not much the worse after a century's wear. There is a difference in the quality of the stone, but there is also a great difference in the quality of the air to which stones are exposed. The rapid decay may, however, be partly attributed to the fact that the stones for Westminster Abbey had not been well selected, and perhaps the stones used at Bath had been for some time exposed to the air before use. Bath stone is, as I have said, an exact opposite to Portland. But we have other stones that are bad. I do not know that I can mention a more remarkable instance than the stone which is obtained at Heddington, in the neighbourhood of Oxford. There are some specimens of the different oolites on the table, and the Heddington is in some respects the worst of all. No one, I think, can have looked at some of the older buildings in Oxford without seeing what a bad state they are in, and how bad the stone itself must be. I have here a specimen of Heddington stone, that has been exposed for a short time to the action of acids, and it shows the way in which such stones will decay. Besides these there are a number of stones of intermediate quality in England, known by various names—the names of the quarries in which they are found. There is the Ancaster stone, the Ketton stone, the Barnack stone, and the Purbeck stone. There is another limestone to which I wish to direct your attention—that is the Caen stone. A vast quantity of stone has been obtained, from time immemorial, from some of the quarries in the neighbourhood of Caen, and some other places near. This stone has been brought over to England almost from the time of the Norman conquest. Part of Canterbury Cathedral is built of it, and it has stood very well. But other stones from the same or from adjacent quarries have gone entirely. They have failed so thoroughly that it is impossible to conceive anything worse. They are even worse than the Heddington stone in the worst cases in Oxford. There is a specimen before me of Caen stone showing decay; it shows the quality of the stone, and it shows the way in which decay takes place. This, however, although a decayed stone, is not a bad specimen. I could not get the sort of specimen I should have been glad of, to show how badly some Caen stone decays. But there have been some buildings erected lately in London, and I am sorry to say that one of them is Buckingham Palace, that show the decay as clearly as can be. Soon after the palace was completed, the stone became in so bad a state that it was positively dangerous for the sentinels to walk underneath it, and it was necessary to remove large portions of it and to substitute stucco; and there it remains to this day painted over. This case, with regard to a common limestone, will show what sort of material we have to deal with. All the cheaper and better kinds of stone are exceedingly liable to decay.

How does limestone decay? It decays in a very simple way, and from the same causes that I alluded to in speaking of sandstones. First there is an exposure to changing temperature, all the limestones being absorbent, and taking in a certain quantity of water. The water is driven in by rain, particularly in what appear to be the sheltered parts of the stone, beneath projections. Then cold comes, and even if the stone has been placed in the building as it lays in the bed, there will be a tendency to throw off successive laminæ, but if put carelessly in the building, or fixed at right angles to the position it was in the bed, so that what was originally the plane of the bed has now become vertical, the effect will be that the whole face of the stone will peel off, and if the stone is cut into delicate ornaments, it is almost inevitable that some of the planes of the bed would interfere, so that when expansion takes place, the outer laminæ of the ornament would break off and fall away. The moment that is done in any one place, absorption becomes more rapid than it was before, and it goes on with increasing rapidity. If, however, the stone lasts for a certain time without injury, the surface hardens. All stone is much harder after it has been exposed to the air for some time than it is in the quarry; and, therefore, if it once gets into this state it may last, but if it is attacked early it will go. There is an instance of this to be seen in Mr. Hope's house, in Piccadilly, which is built of a soft stone. It has been sheltered by putting leads over the tops of the exposed parts; and I have Mr. Charles Smith's authority for saying that, in consequence of that the stone

has been preserved. The water has been prevented from draining down into the stones, and in that way it has had time to harden. The water that is absorbed when limestone is exposed to the air is charged with acids, as I have already mentioned, and under these circumstances the stone acts as a kind of filter. A porous stone acts also in another way, decomposing the gases that pass into it. A certain, though slow, decomposition thus goes on, and the stone becomes actually destroyed. Very often this will take place even when it is not very apparent outside. That is the case especially in some of the Heddington stones. At Oxford you will often see large scales breaking off from the surface of the building, although the outside is apparently pretty good. This is the result of that amount of decomposition and alteration that goes on within the substance of the stone itself.

There is another kind of limestone which I must mention. It is magnesian limestone. The magnesian limestone is carbonate of lime and magnesia; common limestone is simply carbonate of lime. Just as the common limestone when crystallised is very durable, so magnesian limestone, when crystallised (in which case it is composed of equal parts of carbonate of lime and carbonate of magnesia), is in a more compact state than when earthy, and then seems to stand exceedingly well. In the places where these stones are obtained, the churches built of them centuries ago are quite unaltered. But when these same stones are brought into our London atmosphere, although they appear to be just as good, and are exposed to very much the same influences, they begin at once to decay. It was owing to a neglect of the consideration of this matter that the stone used for the construction of the Houses of Parliament has suffered so much. The stone for this purpose was selected with the greatest possible consideration. A commission was appointed of the fittest men of the time—the best geologist, the architect, competent practical men, and the best chemists. All those employed were men of the highest reputation, and no one has hinted for a moment that they did not do their duty. This commission examined the different limestones in the country, and they recommended the magnesian limestone of Bolsover, because they believed it to be the best. They found buildings constructed of it many centuries ago entirely unaltered, and they naturally recommended that it should be employed. Then came a difficulty which had not been considered sufficiently, and that was that the particular quarries which had supplied the stone to the churches in the neighbourhood were by no means large enough to supply the quantity required for the Houses of Parliament; and not only that, but it was not at all certain that other stones could be got in the immediate neighbourhood of precisely the same kind. Other quarries adjacent were selected, and the stone which was used was certainly from the neighbourhood, and nominally the same stone, but really it was exceedingly imperfect. Magnesian limestone differs from common limestone in the way in which it decays. Under the action of those causes that I have already mentioned, it decays whenever the two minerals are not perfectly crystallised together, and then it becomes disintegrated and powdery, so that in one block you will find portions which are perfectly hard, and other portions near them, which are also hard, whilst between these two you will find portions which are perfectly soft, and so disintegrated that the particles might almost be blown away by the wind. This has arisen from the way in which the material was originally crystallised, and from the difficulty that there is in producing a perfect crystallisation in a mass on a large scale in nature. Generally speaking there is a considerable amount of variety both in the composition and subsequent metamorphosis of rocks, so that bedded materials almost always vary a great deal even in a short distance. This is the case with magnesian limestone, but it also appears that neglect was incurred by the want of sufficient superintendence in selecting the best kinds of stone, and rejecting bad samples either at the quarry or in London. There was no sufficient superintendence, and the poor and inferior specimens of stone were not rejected. They were all put into this great building, and the result is that some of the stones are very good, some very indifferent, and some exceedingly bad. The same kind of stone however was used in the new building of Lincoln's Inn, and it is even worse. The same kind of stone, however, is used in the construction of the Museum of Practical Geology in Jermyn Street, and there is not a stone faulty. It would appear then that the selection of stone is a very important matter. So much I may say with regard to the materials and the nature of the causes that produce their decay.

Practically, then, the causes of decay of absorbent stones are connected with exposure to damp atmosphere, rendered impure by various acids and alkaline gases, and also with changes of temperature, especially above and below the temperature of about 38°, at which water attains its greatest density. It is quite clear that where there is a large amount of injurious gases present in the air, in other words in and near large cities, where there are a great number of people breathing and giving off carbonic acid gas, and where a large number of fires are burning, which always yield a large quantity of sulphurous acid, and also where there is much ammonia; in these places, and owing to the state of the atmosphere, stones which in the open country would stand perfectly well, will stand very badly. In addition to this must be taken into account the exposure to certain winds, and the action of the weather to a greater or less extent for a limited time.

The question then arises how these things are to be overcome in our climate. Generally speaking, one would be apt to suppose that non-absorbency was a most desirable thing; and that if we could render stones non-absorbent — that is, if we could prevent them from sucking in the moisture and these dangerous gases—we should be able to answer our purpose and prevent the decay of the stone. I need not inform you that it is no new thing to preserve in this way—not, indeed, stone—but other substances, such as stucco and terra cotta. You can scarcely go into a good modern street in London without seeing a large number of houses covered with cement, and that cement covered over with paint. Now, what is paint? It is a mixture of oil and oxide of lead. The paint coats the surface in such a way that water cannot get into it. We all know the result; the paint, indeed, never looks well; it is not an ornamental thing under ordinary circumstances, and much less so when applied to stones. But how far is it successful? Why the moment it is put on it begins to decay. Decay must take place, because oil begins to decompose the moment it is exposed to the action of the air; and the result is, that after a very short time the oil separates from the oxide of lead, and the surface first blackens and soon begins to peel off. You have a thin film of oil and white lead put on a surface; it adheres slightly for a time, but the moment it is left alone it begins to decompose and rot, and in the course of a year or two you must do all the work over again. Numerous plans have been patented for coating and choking the pores of absorbent stones with preparations of various kinds. The almost invariable idea has been to render the stones as far as possible non-absorbent. This has been done by combining a certain proportion of mineral substance with oil or fatty matters. There is but one observation with regard to these; they all inevitably tend to decomposition except perhaps those that are of a pitchy or bituminous nature.

Bitumen is of a nature that does not decompose by exposure, and is permanent, but it is of so dark and disagreeable a colour that it completely destroys the appearance of stone, and renders it so unsightly that no one could venture to recommend it. Oil and fatty substances therefore are the only ones that have been used. One cannot help feeling that if our stone buildings are to be painted till their character as stone is lost, it would be better to build them of a cheaper material, and use bricks and stucco at once. I may say with regard to the patents that have been taken out within the last twenty years on subjects of this kind, that I have had

no less than seventeen before me, and out of these seventeen eleven are simply mixtures of various substances with oils and resins, and are therefore essentially of the same nature. Some of the others use mixtures of mineral matters in oil, but none of them appear to have answered the purpose, and none of them are now employed at all. There is another point I ought to mention, and that is that a mere mixture of things, not involving chemical combination, must fail. We must then either have some invention by which the pores of stones are permanently choked by a bituminous substance, not unsightly, and not in any way subject to decomposition, or we must find some mineral deposit which we can answer for which will adhere firmly and which will also be permanent; in other words, we must put something into or upon the stone which shall be a mineral substance, closely adhering and not subject to ordinary atmospheric influences.

(To be continued.)

NOTICES OF BOOKS, PATENTS, &c.

Report of the Metropolitan Board of Works. Presented to the Board, 10th August 1860.

Lest the continual appearance of disrupted streets and the occasional calls of the inexorable rate collector should allow us to forget the existence of the Metropolitan Board of Works, we are annually reminded of it by the publication of a Report. The Board appears to think that this is quite an unnecessary proceeding, for a sort of apology for the publication is made in the first sentence, which says that the Report is only made in deference to the Act of Parliament which constituted the Board. It may be some satisfaction however to a ratepayer to know what the money he has contributed has been spent upon, and some pleasure to a Londoner to know what is doing or about to be done to improve the vast city of which he is so proud. All this is duly set forth in the 24 quarto pages of large print which lie before us, and we are bound to say that on paper it looks very little. But contractors and engineers are no doubt better satisfied, and even chemists have reaped some small advantage. The balance sheet, however, if such it can be called, does not go into minute particulars, but only presents us with gross results. The Board received in 1859-60 the sum of 670,193*l.* 14*s.* 7*d.* and spent in the same period 594,828*l.* 14*s.* 8*d.* The outstanding liabilities and mortgage debts on the 25th of March last amounted to 1,740,494*l.* 3*s.* 9*d.* As to the cost of the deodorisation of the Thames in the summer of 1859, we are enlightened in the following paragraph:—

"The application of lime to the deodorisation of the Thames was continued up to the 3rd of September last (1859). The total quantity of disinfecting material used during the summer (including that mentioned in last year's Report) was 4281 tons of chalk lime, 478 tons of chloride of lime, and 56 tons of carbolic acid, at a cost of 17,733*l.*"

Allusion is necessarily made to the means proposed for deodorising the sewage this summer had it been required, and we are informed in a foot note that the Board still intends to make use of perchloride of iron for the purpose. The note is as follows:—"In the early part of the present year the Board proposed to employ perchloride of iron as a means of temporary deodorisation during the summer months, but having had their intention drawn to the opinions of other professional gentlemen which were not favourable to the selection of perchloride of iron as a deodorising agent, they instituted further inquiries. The subject has since been further discussed, but having carefully considered the statements on both sides of the question, the Board have no reasons to doubt the soundness of the conclusion set forth in the first Report of Drs. Hofmann and Frankland." In reply to this it may be said that it was not the employment of perchloride of iron which was objected to. It was the use of chloride of arsenic to which the objectors were opposed.

The disposal and utilisation of sewage also comes in for a short notice. "In directing their first attention to the Purification of the Thames, the Board have been fully sensible of prosecuting the other branch of the same subject, namely, the disposal and utilisation of Sewage matter, and have, for that purpose, by numerous advertisements, publicly expressed their readiness to afford opportunities to any company or individual for testing and developing any well-considered scheme for the useful application of the Metropolitan Sewage. . . . It has been generally supposed that a large class of persons are so persuaded of the vast value of the Sewage of the Metropolis, that they only await the opportunity of putting their schemes into practical operation. This, however, has not been borne out by the experience of this Board. They advertised extensively, inviting tenders for the Metropolitan Sewage. And in answer to these advertisements they only received four proposals. The Board, however, have the whole question under consideration; and though nothing has been submitted to them which enables them to speak with any definiteness upon the subject, they are willing to hope that the period may not be far distant when some satisfactory results may be arrived at which may augment the means at present available of adding to the fertility of the soil, and at the same time become a source of revenue to the ratepayers." We hope so too, for the sake of science as well as the ratepayers. Considering the magnitude of the undertaking, it is rather surprising to us that so many as four proposals were sent in, and we shall be glad to hear that these have been fairly examined. There is nothing else in the Report which is specially interesting to chemists, but we commend the concluding sentence to the serious attention of such of our readers as are householders or owners in the metropolis.

"The Board cannot conclude this account of their labours during the preceding year without again adverting to the magnitude and cost of the Works required for the improvement of the Metropolis, to the total inadequacy of the funds at their disposal for meeting those demands, and to the urgent necessity of providing them with additional sources of revenue; and they entertain the earnest hope that at an early period their repeated representations upon this subject may receive attention in the proper quarter, and result in practical measures, by which they may be enabled effectually to carry out the Public Improvements so urgently required."

CORRESPONDENCE.

Huckster-Druggists.

To the Editor of the Chemical News.

Sir,—"One step from the sublime to the ridiculous" was the apt saying of one of the greatest men of the last age. W. P. when he comes forward as the exponent of the huckster, makes a very bold advance for either one or the other. "I stand up for hucksters; I know their shops *well*; and I never remember to have heard of a mistake which caused death to any one;" but W. P. does not give us a measurement of his memory, neither as to the hearing is he more communicative. A bolder assertion was never penned, unless by a deaf man, and it would be presumption in me and your other readers to supply the hiatus in W. P.'s memory. I will therefore give by your permission one or two other reasons why we should not have huckster-drugdealers.

1. The huckster sells all the drugs in daily use nearly, excepting the poisonous class, and therefore throws upon the druggist the sale of poisons.

2. They are a very illiterate class, many not capable of spelling the name of the drugs they deal in; and are, as to the nature, manufacture, properties, qualities, and doses, perfectly ignorant.

3. They are the great cause of adulteration and import of drugs whose worthless character would never find sale in this country but for them.

4. Their compounds as well as simples are alike of the most filthy description, and are equally as much the generators as the curatives of disease, each supplyer of them to the huckster having generally a private H. to make them by, although we have Pharmacopeiæ directing Opii uncias tres, Spiritus tenuioris octarios duos for laudanum as well for Hodge or the Squire; yet upon an average not more than one ounce of opium is added to sp. and water equal parts. Again, the syrup of violets is as often made with indigo and syrup as with violets. The tinct. rhei is perhaps as great a query or a myth as King Arthur's table, and so with the stock throughout.

5. They rob the honest educated druggist of his bread by their competition, and nullify the endeavours of the Pharmaceutical Society to elevate not only the mental but also the pecuniary status of the druggist. Our students when articled feel it, and when assistant the nightmare is doubly oppressive; they cannot get that remuneration for service which they deserve, and when they become masters they are in many cases unfortunately but short-lived ones. How can it be otherwise if all places are like L——. Here we have 80 druggists and approaching to 2000 hucksters of every degree and grade, with stocks varying from 10*s.* to 5*l.* or 6*l.* The numbers I give you are from a public company's books given me about three years ago, since then the numbers will not have got less.—I am, &c.

JUNIUS.

Chemical Notices from Foreign Sources.

The Congress of Chemists at Carlsruhe.—The accounts of the Congress which have yet reached us are very meagre. We only know that the meeting was attended by one hundred and forty chemists, from all parts of the world, and that the last of the three days was devoted to a discussion having reference to the best method of expressing the composition of chemical substances in the symbolic notation. The debate on this point, it seems, was very animated; but the conclusion arrived at was that the time was not yet ripe for a general agreement on the subject of notation. Everyone was agreed as to the necessity of putting the language of chemistry in harmony with the actual state of the science; but the unanimous opinion of the assembly was that entire liberty in this respect was indispensable to the progress of the science. It seems, however, that it was generally acknowledged that the dashed letters of Berzelius, Ć, Ȯ, S̈, &c. should be used to express double molecules or two equivalents.

I. MINERAL CHEMISTRY.

Salts of the Protoxide of Cerium and of Lanthanum.—Czudnowicz has published[1] the results of an extended series of experiments on the salts of cerium and lanthanum. The cerium salt he started with was prepared by Bunsen's method, somewhat modified, as follows:—Crystals of ceroso-ceric nitrate, containing as well the oxides of lanthanum, didymium, and magnesium are carefully heated in a sand bath to 250° or 300°. The salt at first melts in its water of crystallisation, and then decomposes, losing some hyponitric and nitric acid. A milky mass is then formed. When the brown oxide is seen to deposit at the bottom of the crucible it is allowed to cool, and the mixture is treated with a good deal of water, and water acidulated with nitric acid. By this means a large quantity of basic ceroso-ceric nitrate is separated, which may be purified by decantation. The mother-liquors are treated in the same way as the original salt: one treatment is sufficient to remove from them all the cerium.

The author confirms most of the results announced by Rammelsberg[2] relative to the ceroso-ceric sulphates, and also asserts the existence of two cerous-sulphates—one crystallising in hexagonal prisms, containing $CeO.SO_3 + 3Aq$; the other forming bundles of prisms of the oblique rhomboidal type, containing $CeO.SO_3 + 2Aq$. He then describes several double sulphates of cerium and the alkalies. One double *sulphate of cerium and potassium* is found when cerous-sulphate is mixed with an excess of sulphate of potash. The salt is obtained in the form of a crystalline precipitate. It contains $CeO.SO_3 + KO.SO_3$. When solutions of two parts of dehydrated cerous-sulphate and one part of sulphate of potash are mixed, a granular crystalline precipitate is after a time deposited, which contains $3(CeO.SO_3) + KO.SO_3 + Aq$. Only one *sulphate of cerium and sodium*, $3(CeO.SO_3) + NaO.SO_3 + 2Aq$, can be obtained: it forms a white crystalline precipitate, which is almost insoluble in water. The *sulphates of cerium and ammonium* combine in only one proportion, $3(CeO.SO_3) + NH_4O.SO_3 + 7Aq$. This salt forms crystals of the oblique rhomboidal type, which are frequently flattened, and which lose all their water at 150°. A *platino-cyanide of cerium* may be obtained by mixing solutions of equal equivalents of cerous-sulphate and platino-cyanide of barium. The solution formed, properly treated, deposits beautiful yellow prisms, composed of $PtCy + CeCy + 6HO$. When crystallised in alcohol the double cyanide is white, and contains less water, but on exposure to moist air it changes into the preceding salt, and becomes yellow.

Salts of lanthanum. The author separated the lanthanum from didymium by Mosander's[3] method. The *sulphate of lanthanum* on slow evaporation crystallises in radiating needles having a slight amethyst tint. The salt does not change in the air, and contains $LaOSO_3 + 3Aq$. The oxide precipitated from this salt had a brown tint, probably communicated by a small quantity of sesquioxide of didymium. *Oxalate of lanthanum* is a white crystalline powder insoluble in water, and sparingly soluble in acids. It obstinately retains a small quantity of ammonia when prepared by means of oxalate of ammonia. Dried in the air, it contains $LaOC_2O_3 + 3HO$.

Succinate of lanthanum is formed when succinate of ammonia and sulphate of lanthanum are mixed. It forms a granular precipitate which under the microscope is seen to be composed of fine needles often united together in stellated groups. It is slightly soluble in water, and soluble in acids and an excess of succinate of ammonia. Dried in the air, it contains $2LaO.C_8H_4O_6 + 3HO$.

Tartrate of lanthanum, $2LaO.C_8H_4O_{10} + 6HO$, forms a bulky amorphous white precipitate when neutral tartrate of ammonia is mixed with sulphate of lanthanum. Acids and the tartrate of ammonia easily dissolve it.

Citrate of lanthanum is amorphous at first, but in time becomes crystalline. Dried at 100° it contains $3LaO.C_{12}H_5O_{11} + 5Aq$. Dried in the air it contains 7 equiv. of water. *Benzoate of lanthanum* $LaO.C_{14}H_5O_3$ is crystalline and granular. *Hippurate of lanthanum* $LaO.C_{18}H_8NO_5 + 3HO$ is crystalline, showing beautiful needles under the microscope. *Acetate of lanthanum* $LaO.C_4H_3O_3 + 2HO$ may be obtained by dissolving the carbonate of lanthanum in acetic acid. It crystallises in colourless needles. It begins to decompose when heated 120°, and at a higher temperature is transformed into a viscous mass which swells up.

II. ORGANIC CHEMISTRY.

Action of an Amalgam of Sodium on Sulphide of Carbon.—HH. Löwig and Hermann[4] agitated a pasty amalgam of sodium with sulphide of carbon. They soon remarked a considerable increase of volume in the amalgam, and a great rise of temperature, which obliged them to cool the vessel in which the reaction took place. No permanent gas was evolved. By degrees the amalgam decreased in volume and became completely liquid. After cooling, the

[1] *Journ. für prakt. Chem.* Bd. lxxx. s. 16—31.

[2] See CHEMICAL NEWS, vol. i. p. 130.

[3] Gmelin's *Handbook*, vol. iii. p. 275.

[4] *Ibid.* Bd. lxxix, s. 428.

mixture was shaken up with alcohol, and the black liquor was decanted to separate the mercury. On standing the liquor deposited a black powder formed of protosulphide of mercury; but even after filtration it still contained mercury, which deposited in time in the form of a metallic mirror.

When the solution is distilled in a water bath to get rid of the alcohol and the excess of sulphide of carbon, an almost black amorphous mass remains, which is soluble in alcohol and water, and which gives to these solvents a deep brown colour.

This mass contains sodium, sulphur, and carbon in proportions which the authors represent by the formula C_8NaS_3. The aqueous solution of this body dyes the skin a deep brown; it gives a brown precipitate with nitrate of silver and the salts of copper, and a black with the salts of lead. If dilute hydrochloric acid is added to the black solution sulphuretted hydrogen is disengaged, and a brown-black precipitate is produced; but if the black solution is added to the dilute acid, shaken continually, an amorphous black precipitate forms without the evolution of gas. This black precipitate constitutes the hydrogenated compound C_8HS_3. When the solution is left to itself for several weeks in a well-stoppered bottle completely full, it deposits a black mass, and the liquor contains a compound less rich in sulphur, to which the authors attribute the composition $C_{10}NaS_5$, and which by double decomposition will form corresponding compounds with silver and copper. The substance deposited from the alcoholic solution contains C_8NaS_3. The authors attach only a relative value to the foregoing formulæ; the positive conclusions they think they may draw from the above facts are the following: 1. That an amalgam of sodium reacts on sulphide of carbon, forming high sulphides of carbon belonging to the group of sulphur acids: 2. That the part the mercury takes in the reaction is desulphurising the sulphide of carbon.

Quinic Acid in the Leaves of the Vaccinium Myrtillus.—Zwenger says[9] he has found quinic acid in the leaves of the *Vaccinium Myrtillus*. His process for extracting it is the following: He boils the leaves (collected in May) with milk of lime, and precipitates the clear solution with alcohol. The precipitate he dissolves in water, adds a little acetic acid, and the neutral acetate of lead to throw down the colouring and other foreign matters. After having removed the lead by sulphuretted hydrogen he evaporates the liquor to a syrupy consistence, and then sets it aside for some days, when quinate of lime is deposited. This he dissolves in water, adds sulphuric acid to take away the lime, and evaporates in a water bath. The syrupy residue he dissolves in alcohol, and in this solution there forms after some time oblique prismatic crystals which possess all the characters of quinic acid.

MISCELLANEOUS.

Adulteration of Food Act in the City.—The committee to whom the question as to the advisability of introducing this Act into the City of London was referred, made a report to the Court that they had considered the subject attentively, and were of opinion that it was advisable and expedient that this Act should be introduced into the City, and that the Court should appoint an analyst of competent skill and medical knowledge to carry out the provisions of the Act, and they recommended that Dr. Letheby, the present medical officer, should be appointed to that office. The report also stated that the committee had been informed by Dr. Letheby that the expense of carrying out the proposed object would in all probability be considerably more than the sums that would be derived from the fees to which he would be entitled, and they therefore recommended that Dr. Letheby should keep an account of his all receipts and disbursements during the current year, and render an account to the Court at the expiration of that period, who would thereupon decide what scale of remuneration should be afterwards adopted.

After considerable discussion, the report was unanimously agreed to, and Dr. Letheby was appointed the analyst for the City of London.

The Oil Wells of Pennsylvania.—The oil is found in Pennsylvania, western Virginia, Ohio, New York, Canada, and other places. The wells yield, by pumping, from ten to twenty-five barrels per day of the crude oil. The yield of the refined article of the Pennsylvania oil is about 85 per cent. of the whole. One well gave ten barrels a day of pure oil, which was barrelled and sent to market as it came out of the ground. The owner was not satisfied, and deepened his well, and in eighteen hours 110 barrels were collected from it—but this proved to be very impure. The crude oil burns dimly, and is a very good lubricator, and when refined has less smoke and less odour than any other oil, and is not explosive, while its illuminating power is equal to the best coal oil. In Illinois the oils occur in a limestone, and the loss by distillation is about one-half. These oils everywhere occur, for the most part, about one geological level. The oil seems to have distilled from the carbonaceous deposit below, and it may be the product of animal as well as vegetable remains. Professor Pugh states that the petroleum is used with great success by the students in the institution to which he belongs, and they find it to burn better and to be generally superior to the common oil. Professor Whitney thinks it likely that these oils are of animal origin, as no vegetable had been discovered in the Hudson river formation from which also oils had been obtained.

Tempering Articles of Steel.—A temperature of 570° will produce a dark blue colour on polished steel, and 590° a pale blue. Oil or grease of any kind will answer for drawing the temper of cutlery. The temper for lancets is obtained at 430° Fah., axes at 500°, swords and watch springs at 530°, small saws at 570°, and large saws at 590°. Copper-coloured spots are not produced by tempering; but they may be obtained on the polished surface of steel by immersing the article in a solution of sulphate of copper.

[9] *Annal. der Chem. und Pharm.* Bd. cxv. s. 108.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Acids.—1. Tartaric and Malic. 2. No. 3. By the smell.

A Subscriber.—By solution in Benzole.

B. S. Proctor.—We understand that *Pro Bono Publico* sees the *Pharmaceutical Journal* regularly. She is obliged by our Correspondent's offer.

A. Rosling.—Received. Will appear next week.

Received.—*J. C. Horsley*—*Omicron*—*J. A. Davies*—*T. A. C.*—Answers next week.

Vol. I. of the Chemical News, containing a copious index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

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CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnandon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, Baillière, 219 Regent Street, London.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Migrations of Phosphorus in Vegetables, by M. B. CORENWINDER.

[FIRST PART.]

IN a memoir published in 1857 in the *Recueil des Travaux de la Société des Sciences de Lille*, I have examined in detail the principal chemical modifications which take place in the root of the beet during its second period of vegetation. I have shown in this work that at the time the first leaves are developed, the beetroot loses a certain quantity of sugar, which serves as nourishment for the young shoots. Then, during the growth of the stalks and leaves, the sugar does not visibly diminish in the root, but disappears rapidly as soon as the seed begins to form.

In that memoir I have also proved that no phosphoric acid is found in the root of the beet when the seed has arrived at maturity. These latter have absorbed the largest quantity, and the stalk only contains a small quantity, varying according to circumstances, and sometimes none at all. These first observations appeared to me sufficiently interesting to induce me to study the migrations of phosphorus in other vegetables. This large subject will require numerous researches on my part, but it appears full of interest, because phosphorus is, we know, the element which accompanies the nitrogenous matter in all the phases of vegetable life.

The method of analysis that I have adopted in the following researches to estimate the phosphoric acid, is what I have described in the work just named. To obtain the ashes in a regular and normal manner, I have often had occasion to verify how exact and requisite the precautions are which Saussure prescribes. As he has recommended, the best method to get the ashes white is to expose the dried plants to a dull red heat, and to leave them to incinerate slowly without stirring the matter. If we have the imprudence to disturb it in the hope of hastening the operation, the results are bad, the ashes cake together, and it is then impossible to get them white without losing a great deal. The ash being obtained, I treat it with an excess of pure hydrochloric acid, I evaporate it carefully and dry it, to make the silica insoluble; the residue is then allowed to digest with sulphuric acid for 24 hours. Afterwards it is filtered, and then an excess of alcohol added to the liquid, until there is a complete precipitation of sulphate of lime. After another filtration, I evaporate the liquid, to drive off the alcohol, and if there is no iron in the solution, I precipitate the phosphoric acid by a mixture, previously prepared, of sulphate of ammonia and magnesia, made alkaline by an excess of ammonia. The precipitate of ammonio-phosphate of magnesia is considered as pure if it has the characteristic crystalline appearance. If not, after having washed and calcined it, I allow the pyro-phosphate of magnesia to digest in muriatic acid for 24 hours. In this way the phosphate is perfectly dissolved, but the silica remains insoluble, as well as the traces of iron unnoticed at first. The precipitate is always obtained in a crystalline state upon filtering and treating it afresh by the mixture of sulphate of magnesia and ammonia. This last precaution, without which the results are uncertain, was obligingly pointed out to me by M. Boussingault. I have often had occasion to appreciate the advantages of it. When the solution of an ash contains iron, I boil it an hour with sulphite of soda and caustic potash. I filter to separate the lime and the iron, saturate the filtered liquid with hydrochloric acid, and precipitate the phosphoric acid from it as before. It is of course understood that previously the silica is made insoluble by desiccation, and that if the precipitate sought has not a normal aspect it is to be treated as above. I do not believe it is possible to proceed more accurately to estimate the phosphoric acid in ashes of plants than by the method which I have indicated. The rest is well known.

We all know that Saussure has made a number of researches upon the inorganic elements of vegetables. By a comparison of his analyses, effected upon the plants gathered at different times of their vegetation, he has shown several important facts relative to the variations of phosphoric acid in their mineral part. This eminent physiologist first observed that the leaf of a tree always contains in its ashes more earthy phosphates when just budding out than in the subsequent stages of its vegetation. Quite recently (in 1859) M. Garreau, professor of botany at Lille, has confirmed a portion of Saussure's observations. He has shown that the ashes of the stems and young leaves of buds are rich in phosphoric acid, and he has discovered that the woody stems, after the seed has come to maturity, give ashes which only contain very small quantities of phosphoric acid.

This last fact is analogous to that which I observed in 1857 with beetroot. I moreover showed in the end, that under certain circumstances the woody fibre itself became completely freed from phosphoric acid after the fruit had arrived at maturity.

The researches of Saussure and of M. Garreau were undertaken for the purpose of determining all the saline and earthy matters which exist in vegetal ashes under particular circumstances. I have limited myself in this work to researches on the phosphates, hoping thus to arrive at more accurate results, owing to the subject being more limited in extent.

The ashes of the young shoots of beet, which spring from the roots, are equally rich in phosphoric acid. According to my analyses they contain:—

Phosphoric acid . . . 12·74 per cent.

If this quantity be compared with that which is found in the roots themselves, of which the ashes contain—

Phosphoric acid . . . 12·83 per cent.

it will be seen that the phosphoric acid contained in the roots goes probably at the first moments of vegetation, to assist, along with the nitrogenous matter, in the nutri-

tion of the growing organs. What justifies this opinion, is that the phosphates contained in the beet are not nearly sufficient for the future wants of the seed. According to some observations which I have previously published[1], this may contain altogether five or six times as much phosphoric acid, when at maturity, as originally existed in the root itself. It is not easy to ascertain the precise time at which this latter organ commences to remove from the soil the mineral constituents which are necessary for the leaves and stems. However, I have been engaged upon a series of researches on vegetation, which will perhaps throw some light on the subject.

As I have above stated, the root of the beet contains no more phosphoric acid after the maturity of the seeds. At that time a certain portion may sometimes be found in the stem; but more frequently, when the vegetation has arrived at full maturity, this acid has altogether disappeared.

Young Peas.—The young sprouts of peas are equally rich in phosphates. In the ashes of young shoots of 6 or 7 centimetres high, I found

Phosphoric acid . . . 27·46 per cent.

After the peas had arrived at maturity, I found in the ashes of the dried stalks

Phosphoric acid . . . 4·44 per cent.

(To be continued.)

On Isoprene and Caoutchine[2], *by* C. Greville Williams.

Isoprene and caoutchine are two hydrocarbons forming the more volatile portion of the distillate from caoutchouc and gutta-percha. The fluid produced by distilling caoutchouc has been investigated by numerous chemists including Bouchardat, Himly, and the late Professor Gregory of Edinburgh. The results of their researches were exceedingly contradictory, and the author in his paper, an abstract of which appeared in the last number of the *Proceedings of the Royal Society*, gives an account of all the substances obtained by previous observers, their formulæ and boiling-points being in the original paper condensed into a table, which is, however, omitted in the abstract.

Isoprene.

This substance is an exceedingly volatile hydrocarbon, boiling between 37° and 38° C.; after repeated cohobations over sodium it was distilled and analysed. The numbers obtained as the mean of five analyses were as follows:—

Experiment.		Calculation.		
Carbon . .	88·0	C_{10} .	60	88·2
Hydrogen . .	12·1	H_8 .	8	11·8
			68	100·0

Density of vapour by observation 2·4. Theory requires 2·35. Density of the liquid 0·6823 at 20° C.

Action of Atmospheric Oxygen upon Isoprene.

Isoprene exposed to the light for some months in a partly filled flask, thickens and requires bleaching properties, owing to the absorption of ozone. On distilling the ozonised liquid a violent reaction takes place between the ozone and the hydrocarbon. All the unaltered hydrocarbon distils away, and the contents of the retort suddenly solidify to a pure white amorphous mass, yielding on analysis the formula,

$$C_{10}H_8O.$$

This directly-formed oxide of a hydrocarbon is unique as regards its mode of production.

Caoutchine.

The author confirms Himly's formula for caoutchine, namely $C_{20}H_{16}$, it being isomeric with turpentine.

The relationship which exists between isoprene and caoutchine is therefore the same as that between amylene and paramylene.

Action of Bromine on Caoutchouc and its Isomer Turpentine.

It was found by careful quantitative determinations that one equivalent of either of the above hydrocarbons exactly decolorises four equivalents of bromine.

Conversion of Turpentine and Caoutchine into Cymole.

By the alternate action of bromine and sodium on caoutchine or turpentine, two equivalents of hydrogen are removed, the final result being cymole, having exactly the odour hitherto considered characteristic of the hydrocarbon obtained from the oil of cumin, and quite distinct from that of camphogene.

It was found that the cymole obtained as above from turpentine, caoutchouc, or gutta percha, was readily converted into insolinic acid by treatment with bichromate of potash and sulphuric acid. The acid on being converted into the silver salt and analysed, yielded almost theoretically exact numbers.

Paracymole.

At the same time that cymole is formed there is a production of an oil having the same composition, but boiling at about 300° C. The author has provisionally named it paracymole.

The author considers the results of the action of heat upon caoutchouc to be merely the disruption of a polymeric body into substances having a simple relation to the parent hydrocarbon. He deduces this view from the similarity in composition between pure caoutchouc, isoprene, and caoutchine.

Table of the Physical Properties of Isoprene and Caoutchine.

Name.	Formula.	Boiling Point.	Sp. gr.	Vapour-Density.	
				Expt.	Calc.
Isoprene .	$C_{10}H_8$	37°	0·6823 at 20°	2·44	2·349
Caoutchine	$C_{20}H_{16}$	171°	0·8420	4·65	4·699

In the calculations rendered necessary by the numerous vapour-density determinations contained in this paper, and more especially in those *On some of the Products of the Destructive Distillation of Boghead Coal*, the author had so repeatedly to ascertain the value of the expression

$$\frac{1}{1+0{\cdot}00367T},$$

that he was induced to calculate it once for all for each degree of the centigrade thermometer from 1° to 150°. As it is always easy so to manipulate as to prevent the value of T falling between the whole numbers, the table proved a most valuable means of saving time, the author therefore appended it to his paper in the hope of its proving equally useful to other working chemists.

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[1] *Journ. d'Agriculture pratique*, vol. i. p. 238, 1859.

[2] Condensed from the Abstract published in the last Number of the *Proceedings of the Royal Society*.

On the Absorption of Heat Rays by the Humours of the Eye.

Under this title a very interesting paper has recently been presented to the Academy of Sciences, Paris, by Monsieur J. Janssen, an abstract of which we have now the satisfaction of laying before our readers.

The author states that from a consideration of the facts reported in his memoir he was led to the belief that the humours of the eye would be found to possess the power of absorbing the obscure rays of heat which accompany in such abundance the luminous rays proceeding from our ordinary sources of artificial illumination. He endeavoured therefore to establish the existence of this property, and to measure its amount by very accurately conducted experiments.

The memoir comprehends:—

1st. The determination of the amount of heat which impinges upon the retina in the eyes of several animals, and for various sources of illumination.

2nd. The investigation of the part played by each of the several humours in producing the general effect.

3rd. The diathermancy of the humours, and the study of their mode of action upon the heat.

The apparatus of Nobili and Melloni, as constructed by M. Ruhmkorff, was employed in these researches, and with all the precautions necessary to ensure trustworthy results. It was placed exactly north, and protected from the influence of accidental heat rays both before and at the time of making the experiments. The pile was guarded with a double system of metallic screens; one forming a dark cover around the whole apparatus; the other smaller, covering the pile merely, and capable of being lifted off only at the moment of exposure.

The Eye Entire.—In order to measure the transmission through the entire organ, a portion of the vitreous humour was laid bare at the posterior part of the eye-ball, which was then placed in a receptacle formed of two perforated rings of cork, one of which was provided with a very thin glass for the purpose of retaining the vitreous humour. The eye thus prepared was rested on a plate of metal which carried the screen intended to define the incident calorific pencil. This plate was moveable and allowed of placing the optic axis of the eye in the line of direction of the heat rays, and of removing it to a distance at which the intensity of this heat could be conveniently measured.

By this method of examination the following numbers were obtained as the mean of general experiments:—

Rays which pass through to the retina for 100 *rays from a moderator lamp, incident upon the cornea.*

Eye of an ox.	Eye of a sheep.	Eye of a pig.
7·7	8·4	9·1

With lamps of inferior illuminating power the results were even lower, and so also with an incandescent coil of platinum wire; thus the proportion of rays which pass to the retina decreases rapidly with the illuminating power of the source.

Absorbing power of the several humours.—The author gives in the table appended the results he has been led to adopt:—

Absorption by the several parts of the eye for the heat-rays of a moderator lamp.

	Ox.	Sheep.	Pig.
Rays reflected at the surface of the cornea	4·0	4·0	4·0
Rays absorbed by the cornea	59·8	56·9	57·5
Rays absorbed by the aqueous humour	19·2	30·7	20·6
Rays absorbed by the crystalline lens	6·8		7·2
Rays absorbed by the vitreous humour	2·5		1·6
Rays which penetrate to the retina	7·7	8·4	9·1
Rays incident	100·0	100·0	100·0

From certain theoretical considerations treated in the papers, the author draws the conclusion that the radiations which are suffered to impinge upon the retina have almost entirely been deprived of their obscure rays; hence it follows that the parts composing the structure of the eye must possess the power of effecting a complete separation between the two kinds of radiations,—"The heat which penetrates to the retina appears to be the expression of calorific power for the luminous rays."

Diathermancy.—The examination of the humours of the eye, from this point of view, has shown their mode of action upon the radiant heat to be identical with that of water.

The conclusions which the author deduces from the results of his experiments are stated in the following propositions:—

1st. That among the superior animals the eye, although so perfectly transparent for light, possesses, on the contrary, the property of absorbing most completely the obscure heat-rays, effecting thus a perfect separation between the two kinds of radiations.

2nd. From a physiological point of view this property of the humours of the eye appears important, especially when we consider that in the better kinds of artificial illumination (as in the carcel lamp) the calorific intensity of these obscure radiations is tenfold that of the luminous radiations.

3rd. These obscure rays are intercepted in general with extreme rapidity by the foremost divisions of the eye; for the source cited, the cornea absorbs two-thirds, and the aqueous humour two-thirds of the remainder, so that a fraction extremely small is presented to the other media.

4th. As to the cause of this property possessed by the humours of the eye, it resides almost entirely in their aqueous nature; their diathermancy is identical with that of water.

5th. In conclusion, one more reflection seems natural in regard to our artificial sources of light; ought we not to consider them still imperfect while in the best of them there exists so great a disproportion between the really useful rays and those which are foreign to the phenomenon of vision—a disproportion which again becomes apparent on comparing the actual cost with that which should be theoretically necessary.

"During the course of these inquiries, commenced in January 1859, and of which the principal conclusions were indicated in a sealed packet deposited with the Academy in September of the same year, Professor Tyndall has published a work upon the Diathermancy of the Gases (lecture delivered at the Royal Institution, 10th June 1859). In this memoir he describes an experiment made upon the vitreous humour of an ox eye, in which humour he recognised the property of arresting the obscure rays of a calorific spectrum. He concludes from it that if the obscure heat-rays do not give the sensation of light, it is probably because they never penetrate as far as the retina. This conclusion does not appear to me legitimate, and besides we have just seen that it is not in the vitreous humour that the obscure rays are intercepted. This isolated experiment with which I have only become acquainted since occupying myself with the historical researches necessary in the preparation of this memoir is the only one that I know of which has been published upon the subject now before us."

On the Separation of Iron and Alumina, by A. Reynolds.

The following process for the separation of iron and alumina will be found to succeed when a very small quantity of alumina is present.

To the mixed solution of iron and alumina is added oxalic acid sufficient to prevent the precipitation of the alumina. If there is very little alumina present, the oxalic acid need not be sufficient to keep up the iron as well as the alumina.

The solution is now poured into a mixture of ammonia and sulphide of ammonium; a precipitate of sulphide of iron is formed, which is collected on a filter and washed with water with the addition of a little solution of sulphuretted hydrogen. The filtrate is concentrated if necessary, and boiled with hydrochloric acid and chlorate of potash. This will oxidise the oxalic acid and sulphide of ammonium. The solution is now rendered alkaline with carbonate of ammonia, and boiled for some time, when the alumina will be precipitated.

If a large quantity of alumina is present, care must be taken to add sufficient oxalic acid to keep it in solution.

It is better instead of adding hydrochloric and chlorate of potash to the solution, to heat the chlorate with a little dilute acid in a test-tube, and then to pour this into the solution; for the hydrochloric acid is so diluted when poured into the whole bulk of liquid that it can scarcely act on the chlorate.

If only a very small quantity of alumina is present, the solution must be boiled for a considerable time after adding carbonate of ammonia, and then allowed to stand for an hour or more; otherwise the precipitate will not be visible.

To test the accuracy of the process, a very small quantity of alum was dissolved in water, the solution divided into two equal parts, and one portion was mixed with carbonate of ammonia. A precipitate was produced which could scarcely be seen until allowed to settle to the bottom of the liquid. The other portion was mixed with a solution of iron and treated as directed, and the alumina obtained appeared equal in bulk to that furnished by the other portion which had not been mixed with iron.

A larger portion of alum was taken and mixed with iron solution, and the precipitated sulphide of iron was tested for alumina; — none was found with it.

TECHNICAL CHEMISTRY.

On the Manufacture of Murexide on the Large Scale, by M. Braun.

Murexide may be made direct from guano, either without first isolating the uric acid, or by previously extracting this acid; this gives rise to modifications in the process. The first method is complicated by several difficult operations, so that the author always prefers the second; still it may be useful to give both processes.

Direct Manufacture of Murexide from Guano. The success of this operation depends very much on the choice of good guano; it ought to be as light as possible, because it then contains the largest amount of urate of ammonia. The author has always observed that the quantity of this salt contained in the guano varies, and has never been able to obtain a uniform amount; this is caused by the constitution of the bed of this manure, so that it cannot be made a homogeneous mixture at the place of its embarkation.

In real Peruvian guano M. Braun has never found less than 5 or more than 15 per cent. of uric acid. Yet some technical treatises say that we can only get from 1 to 2 per cent. of this acid from guano; their error is caused by the imperfect methods at present employed for its extraction.

To operate largely and uniformly the following process must be used: a large quantity of guano must be well mixed, in order to obtain a first homogeneous substance, and to always find the proportions indicated by the other substances satisfactory.

The guano is first treated with hydrochloric acid to decompose the carbonate and oxalate of ammonia, the carbonate and phosphate of lime, and the phosphate of ammonia and magnesia. The uric acid is also separated from its base, and especially from the ammonia. This operation is best done in a lead cauldron over a furnace. The acid must be heated to 12° Baumé, and gradually throw on to it an equal weight of guano, after having carefully pounded the large pieces. Avoid accelerating the release of the gas until it causes the liquid to overflow.

Boil the mixture for an hour, then rack it in a wooden vessel; clean the deposit by drawing off the water till all the saline parts are carried off.

The strongest washing water may, if an occasion offer, be employed in the manufacture of ammonia, or be used as manure.

The guano, after this process, is thrown into large filters, which separates it more completely from the water. The product thus got contains from 42 to 45 per cent. of dry substance, and 100 parts of guano give about 30 parts of this dry substance, the proportion of which varies very little, whatever may be the quality of the first substance.

It is in this product that all the uric acid is found, which is still mixed with sand, clay, gypsum, organic debris and extractive matter. The guanine of guano still exists in parts, although other parts have been extracted by hydrochloric acid.

M. Brooman, in his patent of the 6th May 1856, uses for the preparation of murexide this substance, called by him uric acid dry and impure; he treats it first with nitric acid of a strength of 40° Baumé, and then proceeds as he state in his specification. However, M. Braun says that he has not any more than other persons succeeded satisfactorily by following the method indicated. The principal difficulty consists in the volume of the mass, which is too great on account of the small quantity of uric acid, and it cannot thus be treated with strong nitric acid without great expense and running the risk of spoiling it; the evaporation also which is recommended for the filtered solutions is still more difficult.

By these experiments, made in the summer of 1857, the author discovered quite another method, which gives more certain and consequently more uniform results. He has found in each case that alloxan must first be obtained; this is then to be transformed into alloxantine, which soon changes easily into murexide. However, the purification of guano by hydrochloric acid, mentioned by M. Brooman, undoubtedly possesses great value, especially when we wish first to extract the uric acid as will afterwards be explained. To obtain a solution of alloxan by using guano purified by hydrochloric acid, M. Braun proceeds thus:—

Put in an earthern capsule 2·80 kilogrammes of the guano purified and drained in a filter, but still damp, with 0·7 kilos. of hydrochloric acid of a strength of 24° Baumé, and heat all to a temperature of 50° C. Remove the vessel from the fire, add gradually whilst stirring

0·21 kilos. of nitric acid of a strength of 40° Baumé, taking care that the temperature does not rise above 62° C. and does not fall below 44° C. The quantity of nitric acid which has been recommended is suitable for Peruvian guano of medium quality containing 8 per cent. of uric acid. The quantity of this oxidising agent may be increased or diminished according as the guano contains more or less than 8 per cent. of acid. The mixture thus prepared is charged with alloxan, dilute it with an equal volume of water and filter it, then wash the deposit with fresh water. Unite all the solutions and precipitate the alloxan by converting it into alloxantine with a saturated solution of chloride of tin. Precipitation takes place very easily, and it may be seen by trial if it is requisite to add more chloride of tin; it is necessary to wait some minutes before deciding upon this point, so as to give the alloxantine time to form thoroughly; an excess of chloride of tin should always be avoided, because this metal will form a precipitate with other substances held in solution, which will not, however, be large.

The alloxantine settles quickly. The brown supernatant liquid is to be decanted and washed with water containing hydrochloric acid, so as to avoid decomposing the salt of tin. The alloxantine thus obtained is thrown on a filter, dried, powdered finely, and then exposed to warm vapour of ammonia, which transforms it into pure murexide. The easiest plan of performing this operation consists in employing an iron sand bath, on which is placed a cast iron drum, having at its lower part a piece of metallic gauze, over which is stretched fine linen, which supports a thin and permeable layer of alloxantine. On the sand bath the alkaline vapour is evolved from a mixture of sal-ammoniac and hydrate of lime. The upper part of the drum should be left open, so that the aqueous vapour which is formed may find a ready egress; otherwise the substance will become moistened, and will get lumpy, which will interfere with the action of the ammonia. If by any accident this action is not quite completed, the murexide obtained is to be pulverised and treated again with ammonia, of which an excess is more to be recommended than avoided.

The author has also employed chlorate of potassa instead of nitric acid for the purpose of transforming into alloxan the uric acid contained in purified guano; but the plan cannot be employed on the large scale, owing to its expense.

6·72 parts of moist purified guano, containing 2·80 parts of dry substance, or 1·12 of uric acid, were mixed with 22·4 parts of hydrochloric acid, and heated to 50° or 56° C.; then 0·227 parts of chlorate of potassa were added in fine powder. It was constantly shaken, and the temperature observed, so as not to allow it to exceed 60° C. In this manner there were obtained 0·42 parts of alloxantine, which yielded from 0·525 to 0·560 parts of murexide.

(To be continued.)

Reflections on the Bursting of Steam Boilers.

In many cases of boiler explosions the cause may unquestionably be traced, either to the defective state of the boiler itself, to neglect in keeping the boiler properly supplied with water, to overloading the safety valves, to the imperfect working of safety valves, or to suddenly stopping powerful machinery, without the previous precaution of checking the rapid generation of steam. In by far the greater number of steam boiler explosions, however, the cause cannot be traced to any of the circumstances just referred to, many of these explosions taking place during temporary stoppages of the engine, or immediately on resuming work after such stoppages. The cause of such explosions, therefore, appears veiled in mystery, which has induced many reflections, the results of which, now loosely thrown together, are submitted, in brief, for the consideration of parties best acquainted with such subjects, and most deeply interested in devising some mode of guarding against such frightful and distressing accidents, now unhappily of too frequent occurrence, and involving such serious loss of life and destruction of property.

Steam, as generally understood by the term, is known to be produced in two separate states. To distinguish these, on the present occasion, it may be convenient to denominate one aqueous vapour, the other aeriform steam. Aqueous vapour, or, as it might be termed, moist steam, is newly generated steam, confined for a short time under moderate pressure, and at the temperature, or very little exceeding that, of boiling water. Aeriform steam, or, as it might be termed, dry or gaseous steam, is that which is confined for a considerable time under heavy pressure, and at a temperature considerably above that of boiling water. When steam is blowing off from the safety valve of a high pressure boiler, it appears, for a short space, say three or four inches, transparent or invisible, beyond which, under ordinary circumstances, it assumes the white opaque appearance commonly known as steam. There is here an illustration of the two different states of steam. Now, into the transparent or invisible portion of steam just referred to, the hand may be introduced without experiencing any painful sensation, but if passed into the white opaque portion it would be severely scalded. It is no uncommon thing for persons to enter stoves or drying rooms where the atmosphere is raised to a temperature of 400° Fahrenheit, without experiencing any disagreeable sensation, but when exposed to the action of steam at 212° Fahrenheit, they are scalded.

Mr. Perkins, of steam gun celebrity, took out a patent for heating steam, and the fact has been fully established by him and his son that heated or aeriform steam will bear compression to a much greater extent than newly generated steam or aqueous vapour, or, in other words, that heated or aeriform steam does not possess, by any means, so powerful an elastic or expansive force as newly generated steam or aqueous vapour does. The mode of working steam engines expansively, which has been in use in Cornwall for many years, depends upon this principle; a portion of high pressure steam, by no means sufficient to fill the cylinder, is injected into it, when it is found to expand, most probably by a reduction of temperature, and is found to work engines with as much effect as if the cylinder had been fully charged with high pressure steam. More recently a plan has been introduced in America for working steam engines, by what the inventors term the cloud steam principle; in this they inject a portion of cold air into the cylinder, along with high pressure steam, when the effect of the Cornish expansive principle is more completely ensured, and an extraordinary saving in the expenditure of steam for working engines is effected.

When the working of steam engines is suspended for a short period, either to allow the workpeople to take their meals, or to make some trifling repair or alteration in machinery, the common practice is to throw open the fire door and close the damper. Now although this will stop the rapid ebullition, there must still be some vapour

arising from the hot water in the boiler, while the temperature of the steam in the upper part of the boiler will rise considerably. The heat of the iron of the boiler, and the mason work in which it is set, being higher than that of boiling water, will be communicated to the steam, since, under the circumstances, there is no expenditure of heat. It must be borne in mind that when an engine is at work there is a constant expenditure of heat carried off from the boiler by the steam, and further, that when a fire is in active operation the expenditure of heat passing off up the chimney, by far the greater portion of which is expended uselessly, except for keeping up the draught of the fire, is enormous. If this waste of heat could be ascertained, which it never can be, as the rarefied state of the atmosphere in the chimney prevents any true measurement, it would astonish any one who has not given the subject due consideration. Now, on the occasions under consideration, there is a probability that a boiler may become surcharged with aeriform steam, not having sufficient elastic or expansive force to raise the safety valve to allow an escape; but should the aeriform steam, then, by any means be converted into aqueous vapour, the increased pressure so produced might cause the boiler to burst. Many circumstances might cause this change from aeriform steam to aqueous vapour; pumping cold water into the boiler might do it, or even the opening of the dampers to allow the stoker to clear the fire, when a current of cold air would play along the bottom of the boiler and through the flues, which would reduce the temperature sufficiently; but electricity presents the most probable cause for the sudden transition of steam from one state to the other. When a railway locomotive engine is passing over perfectly dry ground during sultry summer weather, the expelled steam passes off in an invisible or transparent state, but when the engine approaches a river, or is passing over wet marshy ground, the steam assumes its ordinary opaque white appearance. At such seasons there is unquestionably the greatest quantity of water in the atmosphere, while everything indicates a state of the most perfect dryness; at such times the water in the atmosphere must be in a gaseous state. When the atmosphere is very highly charged with the elements of water, it never continues long so without some change; sometimes water forms without any sensible convulsion in the atmosphere, but frequently the formation of water takes place simultaneously throughout a great extent of space with explosive violence and flame. This is attributed to electricity: the sudden condensation of large volumes of gases into cold water, having a tendency to form partial vacua, causes violent convulsions in the atmosphere, attended with a succession of loud reports; the water which is formed descends to the earth in heavy showers of rain. The phenomena of thunder and lightning, and the explosion of steam boilers, may proceed from the same cause, although the effects are diametrically opposite. In the atmosphere gases unite and form cold water, and thus convulsions are produced by condensation of volume, but, enclosed in a steam boiler, the gases unite into the powerfully elastic vapour of boiling water, and the boiler is rent asunder by an increase of expansive pressure. When a boiler bursts, the liberated steam rushes upwards with great force, taking off for a time the downward pressure of the atmosphere; at the same time all the force of the surrounding atmosphere is pressed upwards against the remains of the boiler, which follows the course of the exploded steam, until its power is so far expended that the gravity of the iron brings the remains of the boiler back to the earth in a slanting direction. These speculations will, no doubt, appear to most persons as visionary, or even perhaps be regarded as the wandering fancy of a madman; they are, nevertheless, supported by well authenticated data, which suggest an easy and simple mode of guarding against the more common cases of boiler explosions, namely, such as take place in consequence of the temporary stoppage of the engine. Whenever it is found necessary to stop a steam engine, for a short period, the generation and escape of steam should never be wholly suspended: the water should be kept boiling moderately, and a portion of steam blowing off. The latter may be easily effected by raising the safety valve a little, or by having a small pipe with a stopcock inserted in the upper part of the boiler, through which the steam may be continually blowing off as long as the engine is at rest. In addition to this, every steam boiler should have attached to it a force-pump, capable of being worked by hand, so that portions of water may, from time to time, be injected when the engine is not working.

If the existence of aeriform steam was better understood, the practicability and importance of applying steam as a chemical agent, in various manufacturing operations, would become sufficiently apparent. In the state of aeriform steam, the elements of water are so loosely combined that they may be easily separated by any other attractive element with which they may be brought into contact, when confined and in a state of intimate diffusion.

C. J. S

PHARMACY, TOXICOLOGY, &c.

Solutio Atropiæ Glycerinea; a Preparation for the Dilatation of the Pupil in Cataract, Iritis, &c. by Charles R. C. Tichborne.

Since atropia was first brought into notoriety for the above application, by Reisinger, it has completely superseded belladonna where introduction into the eye is necessary, but the extract is still resorted to for painting the eyebrow and cheek in such operations as absorption of a cataract or anything similar, where it is indispensable in order to prevent adhesion of the iris to render the dilatation permanent; no preparation of the alkaloid yet introduced being applicable to the exigencies of such cases. A few of the objections to the use of the extract may be enumerated as follows: — Liability to produce cutaneous irritation; secondly, its requiring great attention in keeping the surface moist with some lotion to prevent its drying; and thirdly, want of cleanliness, as the extraneous manners of the inspissated juice are certainly very much out of place when manipulating with so delicate an organ as the eye; in some cases complete failure results either from the use of a bad preparation or non-absorption from harshness of the epidermis.

Some time ago glycerine was found to possess great solvent properties, particularly as regards the alkaloids and some of the non-nitrogenous organic principles. The author has determined its action and solvent power in connection with atropia with a view to its use as an elegant and efficient mode of exhibiting this substance where permanent dilatation of the pupil is requisite. A saturated solution in glycerine gave on analysis four per cent. (=gr. xvijss. ad. ℥i.) of the vegeto-alkali. It does not dissolve readily in the cold, but is soluble almost to any extent on applying a gentle heat; the excess, if it is not great, deposits on cooling in fine transparent colour-

less prisms, but if the amount is considerable it becomes when cool a solid mass. From this it is evident its solubility in glycerine is much greater than in water, it requiring 189 parts of the latter menstruum to dissolve it in the cold[1]; indeed the atropia is recoverable to a considerable extent by precipitation on the addition of water to the glycerolic solution. The easiest method of making this solution is as follows: — One decigramme (=1·543 grains) dissolved in a few drops of alcohol is added to 20 grammes (= 368·680 grains) of distilled glycerine; the mixture is then subjected to a gentle heat, viz. about 110° F. for half an hour in an evaporating capsule to volatilise the spirit. This will contain one-half per cent. *i.e.* 2·187 grains to the ounce, and may be labelled "Fortior." On smearing the surrounding parts of his eye the writer found (without dropping in any solution) the dilation of the pupil perceptible in 15 minutes, from which time it steadily increased. A weaker solution, *i. e.* one containing one-fourth per cent. made by using one decigramme to 40 grammes, may be used to determine the dilatation, by an un-occasional application, and also to allow for absorption. A solution in glycerine of atropia may be made containing 16 grains to the ounce, without any danger of its crystallising out.

The advantages to be derived from the use of this preparation, are, first, the emollient properties of the glycerine, which by softening and relaxing the scarf-skin, freely allows the absorption of the active principle: secondly, the certainty of always keeping the alkaloid in the soluble form, and thus ensuring equal distribution from the hygrostatic properties of the glycerine, which could not be obtained from the use of any aqueous solution, even in the form of a malate, as in the extract, and also its ease of application, freedom from attention, as it always remains moist, and lastly, the certainty appertaining to the employment of all medicaments of a definite composition.

Laboratory, Apothecaries' Hall of Ireland.

The Detection of Strychnia, by John Horsley, *F.C.S.*

One grain of strychnia dissolved in a little water and acetic acid was mixed with animal and vegetable matter. The whole on evaporation to dryness weighed 110 grains.

Ten grains of the dried compound containing say $\frac{1}{10}$ of a grain of strychnia, were digested for several hours in proof spirit with a little acetic acid, so as to separate the alkaloid, and evaporated to an extract, which was again treated with water and acetic acid, filtered, and carbonate of soda or potash added to a slight excess, washed with an equal quantity of ether (say five drams to five drams of the liquid containing the strychnia) and frequently agitated.

5 drams of the ethereal solution contained			$\frac{1}{10}$	of a grain of strychnia.
2½, or 150 minims	,,	,,	$\frac{1}{30}$	,,
75 minims	,,	,,	$\frac{1}{60}$	,,

One drop of the latter evaporated on a glass slide left a crystalline residue of little spots capable of showing, when laid on white paper, the coloured reaction with sulphuric acid and bichromate of potash equal to $\frac{1}{1000}$ of a grain, and sensibly bitter to the taste.

Six drops, however, evaporated in a glass capsule left a beautiful crystalline residue of a larger character, equal to $\frac{1}{100}$ of a grain, clearly discernible by the naked eye, and the microscope giving very strong reactions with chemical tests of course: this being merely a laboratory experiment, it cannot be said to bear the same relation to the strychnia which has passed through the animal organism, or has had the breath of life diffused through it; as all *organic* matter, in my opinion and experience, despite the statements of others expressed on a former notable occasion, suffers, and reasonably so, a material change by the natural processes of digestion, assimilation, and absorption, that the entire quantity of the poison taken could never be expected to be recovered, and in the case of *small* doses the difficulty would be probably increased still more.

In all cases proofs of strychnia are confirmed by its obtainment in a white crystalline form, its bitterness of taste, development of colour by chemical reaction, as well as the symptoms of tetanus induced on frogs, toads, and other animals.

[1] The author was induced to enter into the examination of the solubility in water from observing the non-conformity of works of reference on this subject. His experiments gave as a mean result 1 part atropia, to be soluble in 189, generally given as soluble in 300 parts, whilst Lowig gives it as requiring 2000; the writer thinks this must be a typographical error, and must be intended for 200 parts. This diversity might be accounted for in some degree, as an amorphous modification, produced by the action of a gentle heat, is apparently much more soluble. This uncrystallisable variety is equally efficient with the other in dilating the pupil.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Lecture VI. *On the Decay and Preservation of Building Materials, by* D. T. Ansted, *Esq. M.A. F.R.S.*

(*Concluded from page* 202.)

It is now many years since a suggestion was made by a French chemist, of the name of Kuhlman, which was apparently very ingenious, and which, to a certain extent, answered the purpose. It was a suggestion to coat the surface of absorbent stones with silica. Now, I have already spoken to you of silica, as forming the great mass of sandstones, and also, to a great extent, the base of granite. Common flint is the form in which we all know it. In that form it appears to be rather an unpromising suggestion to apply it to a surface in such a way that it shall adhere and be permanent. Silica, which is in fact a combination of a base which is called *silicon* with oxygen, is also called by chemists *silicic acid*, but the acid properties are so weak that they cannot be recognised by the senses, and its affinities for alkaline bases are very feeble Silicic acid, or silica, is capable of existing in combination with water, and in combination with some alkalis is soluble; is found in nature, combined with water, in some minerals, and when in that state is passed into a state of insolubility by the action of alkaline carbonates, among the rest carbonate of lime.

As a natural hydrate, or combined with a small quantity of water (about 3 or 4 per cent.), it forms part of some particular kinds of sandstone. It is also found in natural hot springs, and even in common spring water—no doubt by the action of carbonic acid. I have said that it is soluble in caustic alkali. It is soluble, for example, in caustic potash and caustic soda, not under ordinary temperature and pressure, but at a temperature of 300 or 400 degrees Fahrenheit, and under steam pressure. Under these circumstances there is no difficulty in dissolving it. You get a solution in this way, a mixture of silica and potash combined with water, and a tenacious though soluble fluid. I have a specimen of it before me. You see it is perfectly fluid; it is as much a fluid as water would be; but if in this state you expose it to the action of the ordinary air for a time, it hardens, becoming first sticky and gelatinous. It is then a hydrate of silica. To become this it undergoes a certain kind of decomposition, parting with its potash to carbonic acid in the air. Before the lecture I placed a drop of the fluid solution on a piece of glass, and those who take an interest in it may see what the

effect has been. It was perfectly fluid; it is now quite gelatinous and sticky, and in a short time it will become perfectly hard. It has attached itself, also, firmly to the surface of the glass, and could not now be removed. In this form it was proposed to use the liquid silicate of potash or water-glass by M. Kuhlmann, whose process consists in the coating of absorbent stone with the solution in question, and he believed that after this treatment the stone would become coated with silica. Since it is known that silica laid on and dried is insoluble, he believed he had secured a useful result; but he forgot that insoluble silica that has been deposited in that way is still capable of being acted upon by the alkaline carbonates. Therefore, even when thus deposited, still in the course of time the alkaline carbonates of the atmosphere would act upon it, and it would be a failure. But that is not all; for, if at the time I put this drop on the glass I had not taken care that the glass was dry, or if I had dashed water on it it would have been washed away. Now that is exactly what would happen if you put some of it on a stone, and a shower of rain were to fall. In that case the effect would be destroyed, the preparation being washed away. So much for the process which Kuhlmann invented. It is right to say that M. Kuhlmann himself believed that when used in limestone a double decomposi ion would take place, the silicate of potash being not only decomposed by the carbonic acid of the air, but a part of the silicic acid combining with the lime to form silicate of lime. This would, however, be a work of time, which the weather in a damp climate would not permit.

Another process has been introduced by Mr. Ransome. His plan was to decompose the silicate of potash and to produce a deposit of mineral upon it, which would adhere to the stone by a process of double decomposition. He considered that if a mineral deposit could be absorbed into the stone, I mean if, after a solution was absorbed into the stone, it could afterwards, by a chemical combination caused by another solution subsequently absorbed, be decomposed so that a solid film would be everywhere deposited, and if this could be done in a very brief space of time, so that damp, air, and rain should have no effect upon it, then the object required would be attained. It suggested itself to him in this way:—He was in the habit of manufacturing the soluble silicate on a large scale, and he thought that by combining it with the chloride of calcium (muriate of lime) he would get this double decomposition. This is the case, because soda and potash have but a weak affinity for silica, and lime a very strong one. Silica, therefore, parts very readily indeed with soda or potash to lime, whilst the chlorine would, with great readiness, pass to the soda. He therefore attempted the process; and I think you will say he attempted it with some success, at any rate so far as the experiment went. There is, however, no obscurity about the general result, as it is simply a matter of experiment. The first thing he did was to satisfy himself that he could get a rapid deposit. In the two glasses before me, one contains a certain proportion of silicate, and the other contains a corresponding proportion of the chloride of calcium, so that the two shall combine and form solids. In mixing these together, I put the chloride of calcium into the silicate of soda. The result is that the affinity of the chlorine for sodium being greater than that for calcium, while the affinity of the silica for soda is weak, a double decomposition takes place, the chlorine leaving the calcium to pass to the sodium, thereby forming soluble chloride of sodium or common salt, and the silica and lime set free, also combine to form silicate of lime, an insoluble salt, which is immediately thrown down in a solid state. The proportions being properly taken, the whole of the water is taken up and made use of as water of solidification, and the salt can be subsequently removed by washing.

[The Lecturer, while performing the experiment, stated that by the time the lecture was over the whole of the contents of the glasses then liquid would be in a solid state, and added that unless it was removed before long, the solid silicate of lime formed would adhere to the glass so firmly that it would be very difficult to get it off.]

We thus have silicate of lime rapidly formed, and being obtained in this way it is necessary to consider what the result would be in the solution of the problem before us. I need not say it is by no means sufficient to have an insoluble mineral deposit placed on the surface of a mineral, whether calcareous or silicious. It is not only necessary to have that, since there must also be cohesion, and this cohesion must be sufficiently powerful to render the mineral coating preservative. It is absolutely necessary that the silicate of lime should be a material which, when put on a surface of stone, should not only remain there, but become permanently adherent. Experience, however, has long ago shown that a very thin deposit of this peculiar mineral, silicate of lime, does adhere with singular rapidity, and with the most remarkable tenacity, to particles of sand and stone with which it comes in contact. It is the film which, produced gradually, gives all its value to mortar, and which cements together the stones of which are formed what builders call concrete, on the very existence of which as a firm solid mass, half our buildings depend. Immediately on the deposit of the minute particles produced by the double decomposition of two minerals and formation of two others, this strong tendency to adhere comes into operation. The particles of silicate of lime newly set free, immediately and firmly attach themselves to the particles or grains of which the stone is made up, not only surrounding them, but binding them to each other, just as when mortar has long been left to harden it is as difficult to separate the parts cemented as it is the solid brick or stone; this it is which gives its principal value to the method suggested.

I have laid on the table several specimens of different materials which have been treated in this way, and also some of the results after they have been exposed to decomposing agencies. Near me are two specimens of terra cotta. One has not been treated in any way, and it is exceedingly absorbent, and we know from exp[illegible] that terra cotta soon becomes injured on exposure to the weather. The other has been treated by the processes that I have mentioned, and if any one will take the trouble to scratch the surface, he will at once see the nature of the change. The surface has become excessively hard, and although when treated this way it is not necessarily non-absorbent, it can be made so by repeating the process often enough. If not made non-absorbent, however, it has become less capable of injury by exposure. These specimens were prepared at the Museum at South Kensington.

There is also before me a specimen of Heddington stone exposed to Ransome's process, and another specimen of the same stone not exposed to that process. Both of them have been dipped in acid, and the result is as you see. The surface of one is entirely gone; the surface of the other is not touched. There are also two specimens of Caen stone, one exposed to the process and the other not. Both have been subjected to the same amount of acid, and the result is that one stone is entirely destroyed and the other is not injured. There are several other specimens of Mr. Ransome's stones on the table, and the hardness of them will be at once recognised by anyone who will compare them with similar stones not so treated.

There is another process which I ought to mention, which has been partly carried into operation in the Houses of Parliament. It was introduced by a Hungarian gentleman of the name of Szerelmey.[1] I can hardly with propriety say

[1] Since the lecture was delivered a correspondence has been printed by order of the House of Commons which renders some further observations desirable:—Mr. Szerelmey had not, I now find, allowed me to ascertain the real nature of the method he adopted, which consists in the use of soluble alkaline silicates, succeeded by a wash of bituminous matter also in solution. This was stated in confidence to Dr. Faraday, who, however, does not say that the application of the soluble silicates is succeeded by a second wash producing a deposit of silicate of lime. We are led to infer that the second wash is the bitumen only, and the object of this must be to shelter the surface while the alkaline silicate is undergoing slow decomposition and becoming converted either into hydrate of silica, or silicate

anything about it. I know too much and too little about it to be able to express an opinion. At the same time, if I did not mention it, it might seem as if I had not been aware of it. Mr. Szerelmey, at the suggestion, I believe, of the late Sir Charles Barry, asked me to look at his process, but he did not inform me what its preservative power consisted of, and although he intimated its nature, he evidently intended me to regard what I observed as confidential. All I can say is, that regarding it as a secret process, it is quite impossible for anyone to express an unqualified opinion of its value until time shall have tested its capabilities. It is therefore best not to speak of it all until it has been exposed for a number of years to the action of the weather. Time alone can show what its value is, if the materials employed are not stated, and certainly an experience of not less than several years can be regarded as of any value, since ordinary paint or drying oil will preserve absorbent stones for that period.

In returning now to the original subject, let me remind you that if, as seems to be the case, we are forced to make use of soft perishable material for purposes of decorative work in architecture, if we are obliged to accept the material that nature has provided near at hand, and select from varieties which differ indeed much in durability but all of which decay, it would seem only reasonable that due precaution should be observed to take for the best work the most favourable varieties of stone, and use great caution in rejecting manifestly bad or indifferently good samples. That this can be done every quarryman and every stonemason well knows, and there are means of determining the good from the bad which are independent of their experience. Where enormous sums are to be expended on decorations for a permanent building, it is surely not unreasonable to expect and require that a little niggardly economy in regard to the material of construction should not be indulged in. But I regret to say that in most modern public buildings, it has not been thought necessary either to determine the kind of stone with reference to its probable durability, or to appoint a competent person to reject on the spot bad samples. With regard to our architects, it seems hardly to be a part of their education to inquire into and understand such matters, and they do not consider themselves responsible ultimately for the consequences of neglect. I have endeavoured to show what must happen when bad stones are placed in a building erected in or very near a large town. The whole of the stone decays, but the more prominent and the more ornamental parts, those on which the effect most depends, and on which most money has been spent, these decay first. Moisture is absorbed, frost comes, and the delicate projecting parts fall. Gases and acids are absorbed together with smoke, and the stone is first blackened and disintegrated, and then reduced to powder. But of course there are bad and good pieces; there are exposed places and sheltered places, and the result of this is that not only does the stone decay, but it decays with the utmost irregularity: adjacent stones become very soon in a state so different that no one could have supposed they were dug from the same quarry, and the whole surface is unsightly and disfigured.

None of the nobleness and beauty of decay is seen in these cases. There is a decent and picturesque appearance, not unfrequently met with in old buildings, which inspires respect instead of dislike. There is the hoary front of age, of which none complain. It is seen in the marbles of Greece and Asia Minor, in the limestones of Rome, and even in some of the porphyries in Egypt. Time, we are told, devours all things. All human contrivances must submit to it, and as it is a natural, so it is often a beautiful condition. But premature decay, like an artificial ruin, has a poor and mean appearance. It does not give the idea of waning strength, but of absolute innate weakness. It is a *coup manqué* — a thing not merely imperfect, but unnecessarily imperfect.

It is important to remark also that bad stone was not always used. Many of our old buildings have scarcely shown incipient decay—many of those in large towns have decayed so as not to be unsightly. This, it is true, must not be altogether attributed to the material, as such buildings, if erected now with picked stone from the same quarries, would probably injure much sooner, owing to the much larger quantity of impurity in the atmosphere to which they are exposed. When a stone has been for some time exposed to pure air it hardens, and thus buildings, placed where we see them before the large towns arose around them, have stood exposure better than they could do now. But there is reason to know that the selection of stone was much more careful formerly than it has been lately, and the result is manifest.

There is one more point. If the method of protection and preservation so ingeniously contrived by Mr. Ransome is successful, as it really seems to be, the softer and cheaper stones may be used. It is certainly the case that a hard, almost flinty, surface is obtained by it, and that such surface is not acted upon by the acids which rapidly destroy the same stone when unprotected. For four winters stones thus protected have stood the action of the weather, and if it turn out to be as durable as seems likely, from this and other trials on a large scale, if absorption is checked — so far at least as its injurious effects are concerned — for mere absorption does not seem to be injurious, and if decay is thus arrested, then there are means at hand which cannot fail to have a great influence on decorative stonework, for the material most easily carved and sculptured is just that one which is most completely improved by the process.

In thus speaking of the decay and preservation of stone, I have endeavoured to confine myself strictly to the subject before me, not travelling out of the record. I feel, however, so convinced of its importance that I offer no apology for bringing it before you, and, perhaps, when in your summer ramblings you visit some noble cathedral, or wander over the ruins of some ancient castle or tower of classical or middle age construction, you may feel an interest in examining the cause of the beauty you there see arising from decay, and contrast it with the dissatisfaction and disappointment I am sure you cannot help feeling on examining some of the recent restorations of Westminster Abbey, or the richly decorated surface of the great palace of the nation immediately adjacent.

of lime, just as by Kuhlmann's method. It would thus appear to be Kuhlmann's process with the addition of a bituminous and temporary sheltering surface. It still remains to determine whether by this process permanent protection is given, as if the deposit consists of hydrate of silica, the alkaline carbonates to which it must soon be exposed will no doubt destroy it. The temporary shelter of bitumen cannot be taken into account as having permanent value, although for the time it lasts it may no doubt appear to be more efficacious than anything else. I observe that Dr. Faraday, in expressing a qualified opinion on the present appearance of the stone thus acted on, speaks "of the short and insufficient evidence now existing." It is indeed clear that the real value of the method of Kuhlmann depends on the nature of the deposit formed, and I believe it has not yet been determined what this is, simply because there has not been time enough given for the experiment. Complete exposure of a surface protected by Mr. Szerelmey left without any subsequent treatment for some years (four at least) could alone decide the question. The condition of the Speaker's Court, in the houses of parliament, will thus, after a time, be a fair test of the value of his method.—D. T. Ansted, 26th May 1860.

PHARMACEUTICAL SOCIETY, 3 *October* 1860.

T. M. Morson, *Esq. President, in the Chair.*

The first meeting of the season was held on the above evening, when the distribution of the prizes obtained in the past session took place.

Professors Redwood and Bentley addressed the meeting, and expressed the satisfaction they felt in awarding the prizes on this occasion. The answers of the students had been unusually good this year. For botany and materia medica it had been decided to give two medals instead of one, the answers of the two successful competitors being of great and equal merit.

The Chairman then presented the medals and certificates with appropriate speeches.

Chemistry.

Medal	. .	Mr. Hooper.
Certificate	. .	Mr. Powers.
„	. .	Mr. Hall.
„	. .	Mr. Holmes.
„	. .	Mr. Waugh.

Materia Medica and Botany.

Medal	. .	Mr. Hooper.
„	. .	Mr. Hall.
Certificate	. .	Mr. Waugh.
„	. .	Mr. Holmes.

No paper was read on this evening.

NOTICES OF BOOKS, PATENTS, &c.

Chemistry of Calico Printing, Dyeing, and Bleaching, including Silken, Woollen, and Mixed Goods, Practical and Theoretical. By Charles O'Neill. Manchester: Dunnill, Palmer & Co. London: Trübner & Co. 1860.

Of all the branches of applied chemistry the subject here treated of is, we think, the one which has met with least assistance from the man of science. Whilst the modern system of chemistry was just emerging from barbarism, and whilst the first chemists of the day were fortunate if they could explain decompositions which are now familiar to a three months' student, the calico printers and dyers had gradually built up for themselves a system of chemical reactions, many of which are even now inexplicable by the existing laws of science. A youth may have completed a successful chemical course under a professor of European renown, and yet know nothing of what is required in a print works. He will not only have much to learn but he will have also a great deal of favourite knowledge to unlearn. He may have gained a well deserved reputation as a skilful and scientific analyst; he may have added to the stock of organic science and barbarous nomenclature by an elaborate investigation; and may have Fresenius at his fingers' ends, and yet he will see how inefficient his scientific knowledge is to suggest even a probable explanation for many of the chemical facts hidden under the terms "mordanting," "ageing," "dunging," "bowking," "bleaching," "steaming," &c. He will find precipitates forming where there should be none, and transparent solutions where there should be precipitates. He will find insoluble matters easily dissolved by rude and unscientific menstrua, processes in use which appear incomprehensible or absurd, and proportions of salts prescribed which seem to set the doctrine of equivalents at open defiance. Close study and observation are gradually reconciling these apparent anomalies, but much still remains to be explained, and although enlarged experience will soon show him that the chemistry of grains and test-tubes is different from that of a manufactory employing tons and thousands of gallons, he will see that these differences are only caused by the operations of a wider law than can be learnt in the scientific laboratory, and he will adhere more firmly to the true principles of his science. Many young chemists have failed to make themselves useful in practical establishments because they have tried to apply high science without sufficient experience. There is no chemical theory of dyeing worthy of the name. At this moment there is no single experiment on record which will enable the student to judge whether the colouring of a fibre by dyeing is a chemical phenomenon properly so called or not; nor a quantitative determination of how much alumina, iron, or tin may combine or be attached to cotton, wool, or silk; nor how much colouring matter may combine with those metals; nor whether there are any definite compounds of these metals or not.

Although much may be said to show that the art of dyeing may be brought to great perfection without a knowledge of scientific chemistry, yet an acquaintance with this science will lead to far more successful and economical results. The want of a better knowledge of chemistry in print and dye works is a constant source of loss and trouble to the employers. They are subject to losses from impurity and deficiency of strength in their drugs, from waste of valuable materials used in unnecessary quantity, from accidents which might have been avoided; and in many cases are helpless in the hands of servants of little skill or integrity, and by a guilty collusion become the easy victims of dishonest tradesmen. With a more accurate and extended knowledge of chemistry many causes of failure now only guessed at could be traced with certainty to their origin, and the recurrence of the accidents guarded against. In calico printing and dyeing very small causes produce serious effects, and it is difficult for the highest intelligence to discover the particular stage at which a given result has happened, and if there why it has happened, unless that intelligence be backed with a competent chemical knowledge. The extension of chemical knowledge would not only tend to correct errors, and give more certainty to existing methods, but it would enable new methods to be contrived and new colours to be produced to a much greater extent than has hitherto been the case in this country. The following extract from this work will show how bountifully chemistry is capable of repaying those who woo her earnestly, and what rich prizes are still in store for the zealous experimentalist:—

"The intelligent dyer or printer can no longer afford to have his business conducted in ignorance of chemistry, for new colours are being introduced entirely different from the older supplies, and requiring a different kind of knowledge on the part of those using them. It is only now that the scientific chemist is beginning to show that he has ceased to be simply a pupil of the dye-house, endeavouring merely to understand and explain processes known for centuries before there was any chemical science; the chemist is now taking higher ground, presenting new tinctorial matters, the products of recondite chemical reactions, and indicating entirely new processes of treatment. Picric acid yellow, aniline purple, and murexide red, are as much artificial preparations as a watch or a steam engine, and as different in their origin from the colours of logwood or indigo as the obsidian knife of an early Mexican is from a polished steel blade. Nor is it likely that the operations of the laboratory will stop with the production of these colours; vast regions remain yet to be explored, and many a brilliant and useful pigment is now known to exist, requiring only further working and knowledge to make it available to the trade. If further inducements were necessary to encourage the study of chemistry among those who have the direction or management of establishments, attention might be drawn to the pecuniary advantages of a dazzling nature it holds out to the successful investigator, and at the same time to the many opportunities which are afforded to skill and perseverance of economy successful. The number of colouring matters at our disposal is very limited, and the processes by which they are applied is very tedious and expensive. For example, there is only one fast red upon cotton, which is from madder, and only one fast blue, which is from indigo. Can neither nature nor art add to these two substances? Nature has indeed been well explored as far as her spontaneous productions are concerned, and seems to answer in the negative. Chemical science and art have not yet answered, except we take the murexide purple and fuchsine pink as the first feeble attempt at what will soon be a more successful reply. Day by day the relations which exist between the various vegetable matters are being more clearly perceived, and in proportion the power of the chemist to mould them to his purposes increases. Synthesis is now as common in organic chemistry as analysis was some years ago. The solitary feats of the artificial production of formic acid and urea, so celebrated in their day, are now equalled every month. Na-

ture works only by natural laws given at the first impulse of creation, and in so far as the chemist has possession of the elements, and can direct the forces of nature, so long may he look forward to the readier and more economical production of natural products. As sulphuric acid was at one time made in small quantities, and with difficulty, from the distillation of native sulphate of iron, and is now made abundantly and cheaply from its component elements, so there is no doubt the colouring principles of many a costly dye wood will be produced in the future course of chemistry. What sources of fortune and renown there are in prospective here every printer and dyer knows who has seen the avidity with which novelty is received, and who feels the vast extension of which his art is capable."

We have quoted sufficient to show the value of cultivating this branch of applied chemistry. For those who may be induced to enter into the details of the arts here treated of this book will prove invaluable. They will find set forth clearly yet accurately the properties of the chemical materials used in printing, dyeing, and bleaching, with a description of their actions upon one another, and as far as possible an explanation of the conditions necessary to success in every department in these arts. Full details are also given of the methods of detecting adulterations in, and estimating the strength of these substances; and in the addenda are given copious and valuable references to English and foreign journals and magazines containing articles connected with this subject, (in which, however, the CHEMICAL NEWS is styled "Chemical Times,") together with a full list of the patents taken out for dyeing, printing, and bleaching, for the years 1858, 1859. The author, a gentleman of great practical acquaintance with most branches of the art, and also an experienced chemist, deserves the thanks of all those who are interested in dyeing or printing for having given to the world the best book which we have yet seen on these subjects.

CORRESPONDENCE.

Combinations of Hydrogen with Iron and Zinc.

To the Editor of the CHEMICAL NEWS.

SIR,—It is not customary in chemistry to publish researches which have "resulted in failures," but I will not absolutely deny that in some cases it might be of use to do so. When, for instance, the experiments are of a nature to require much work and great expense, the communication of their failure might save others time and money; when the methods employed are new and ingenious, they might serve in analogous cases, or suggest valuable ideas. But when neither of these is the case, I do not think an innovation on the general practice adopted by the chemical world would be of interest to the public, or promote the progress of science.

These remarks presented themselves to me when reading Professor Cameron's article on *The Non-existence of Combinations of Hydrogen with Iron and Zinc*. Besides speaking in general terms of "numerous attempts" which "resulted in failures," Professor Cameron describes two very simple trials by which he satisfied himself that there was no iron contained in the hydrogen gas evolved by the dissolution of iron turnings in diluted sulphuric acid. This being the whole *contents* of the article, it occurs to me that neither the experiments which have been executed, nor the Professor's "doubts as to the possibility of forming such compounds," can in the least degree justify the title with which the article is headed. In fact no experimental researches can ever prove the "non-existence" of a chemical combination, and it appears, therefore, quite gratuitous when the author admits that he has not "proved the utter impossibility" in this case.

As it appears that Professor Cameron proceeds from the idea that metallic combinations of hydrogen must be gaseous, I beg permission, for the benefit of future investigations on this subject, to draw attention to the admirable and important researches of Wurtz upon the combination of hydrogen with copper. The Cu_2H, which the eminent French chemist discovered, is a solid compound. It is obtained by treating $PO,BaO + 2HO$ with sulphuric acid, separating the sulphate of baryta, and adding a concentrated solution of sulphate of copper to the liquid. At 70°C. a brown powder is precipitated from the mixture, which is washed with water charged with carbonic acid, and cautiously dried. The Cu_2H thus obtained is very easily decomposed by exposure to the atmosphere, and also by chlorine, hydrochloric acid, &c.—I am, &c.

X. Y. Z.

Cognac Oil.

To the Editor of the CHEMICAL NEWS.

SIR,—Can any of your correspondents favour me with information respecting the "Cognac Oil," "Brandy Oil," or "Œnanthic Ether" of commerce? I am anxious to know if it is a natural or an artificial product; if the former, from what portion of the grape residue is it obtained, and how? if the latter, what is its source?—I am, &c.

H. N. D.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Composition of some Chinese Alloys.—Braunschweiger[1] has analysed some Chinese alloys, which were used to wrap camphor in or line teachests. The composition and density were as follows:—

	Density.	Sn.	Pb.	Cu.	Fe.	Zn.
I.	10·0	26·30	72·30	traces		
II.	10·41	9·64	89·30			
III.	11·11	61·4	93·76			

Analysis of Tin Foils.—Stoelzel[2] examined a good many specimens, and found that all contained from 0·38 to 2·41 per cent. of copper, and from 2·41 to 0·04 per cent. of lead. There were also traces of iron and nickel, which the author regards as impurities. The lead and copper, the author thinks, are useful in increasing the hardness and tenacity of the tin. The lead and copper he found in proportions which seemed to indicate that they in some way replaced one another—the maximum of copper being always found with the minimum of lead, and *vice versâ*.

Hypochlorite of Alumina.—Orioli[3] recommends hypochlorite of alumina to be used as a bleaching and disinfecting agent, instead of the hypochlorites of lime and soda. It destroys more promptly, he says, organic colouring matter and gaseous matters of a mephitic nature.

II. ORGANIC CHEMISTRY.

The generation of Fuchsine or Fuchsic Acid.—Our readers will remember that some time ago M. Bechamp asserted[4] that the formation of fuchsine was the result of the oxygenation of aniline, by the reduction of an oxysalt of a reducible base, or other compound which could directly or indirectly furnish oxygen. In support of this opinion he asserted that in the formation of fuchsine by means of stannic chloride, stannous chloride was formed. Thus:

$$3C_{12}H_7N + 2SnCl_2 + HO = 2(HCl,SnCl,C_{12}H_7N) + C_{12}H_6NO.$$

MM. Persoz, V. de Luynes, and Salvetat, now come forward[5] and bring a number of facts to disprove M. Bechamp's assertion. In the first place they say that fuchsic acid—for fuchsine it seems is a true acid—is formed by anhydrous aniline and anhydrous stannic chloride, without the intervention of the equivalent of water which figures in M. Bechamps' equation. Secondly—no stannous chloride is formed in the

[1] *Neu Repertor. für Pharm.* Bd. ix. s. 72.
[2] *Polytech. Journ.* Bd. clv. s. 124.
[3] *Polytech. Notizblatt*, 1013.
[4] CHEMICAL NEWS, vol. i. p. 311.
[5] *Comptes-Rendus*, t. li. p. 358.

process. To prove this it is only necessary to dilute the rough product of the reaction with alcohol, and treat it with a large excess of ammonia, which neutralises the excess of acid and dissolves the fuchsine, leaving the tin in the state of insoluble oxide, which when washed and dissolved in hydrochloric acid, presents all the characters of a stannic salt.

Thirdly, the authors say that stannous sulphate heated with an excess of aniline, will produce well characterised fuchsic acid. They prepared the stannous sulphate by treating tin with equal equivalents of hydrochloric and sulphuric acids, and evaporating the solution obtained to dryness, whereby they obtained the stannous sulphate in the form of a very hygrometric white powder.

In support of his theory M. Bechamp quotes the action of arsenic acid on aniline which, he explains as follows:—first, he says, an acid arseniate is formed which, reacting on itself about the temperature of 190° or 200°, furnishes water, arsenious acid, and an amount of fuschine proportional to that of the arsenious acid formed. This experiment the authors of the present communication could not succeed in repeating. They rectified some English aniline, and to 10 grammes of the pure product they employed 12 grammes of pure arsenic acid dissolved in 12 grammes of water. This mixture they gradually heated from the ordinary temperature to 180°, and in the space of seven hours most of the aniline was changed into fuchsine. By the most careful treatment of the residue the authors could only discover a mere trace of arsenious acid—which clearly proved that the arsenic acid was not reduced in the process, and convinced them that fuchsine is not a product of oxidation. They believe the reaction to be the same as that which gives rise to indisine, the violet matter obtained by Mr. Perkin.

MISCELLANEOUS.

Genuine Food for the Poor.—The Corporation of London have decided to introduce the Adulteration of Food Act into the City of London. The Committee to whom this question was referred have reported that on attentive consideration, they consider it advisable and expedient that the Act should be introduced into the City, and that the Court should appoint an analyst of competent skill and experience to carry out the provisions of the Act; and they recommended that Dr. Letheby, their present medical officer, should be appointed to that office. Their report also stated that the Committee had been informed that the expense of carrying out the proposed object would, in all probability, be considerably more than the sum that would be derived from the fees to which he would be entitled. It is, of course, impossible to ascertain at present what may be the amount of labour, time, and expense attaching to the fulfilment of the duties of this office. The report, therefore, recommended, in accordance with an arrangement to which Dr. Letheby had given his consent, that the public analyst should keep an account of his expenses and disbursements during the first year, and also of the labour done, and should render a return to the Court at the expiration of that period. The Court would thereupon decide what scale of remuneration should be afterwards adopted. The scale of fees ranges from 2*s.* 6*d.* to 10*s.* 6*d.* for each analysis that is required. It is obvious that these payments will be insufficient to cover the actual expense that would necessarily be incurred by the analyst, and it is sufficiently clear that if this office is to be filled by a chemist whose time and opinions have any value, his services must be remunerated. It was ingeniously suggested that the low rates of payment fixed by the Act afford an inducement to tradesmen to employ the services of the analyst at this trifling fee, in order to get their goods advertised as being pure; and that whereas a certificate of chemical purity and excellence has not hitherto been obtainable at a cost of less than from two to five guineas, henceforth the market price will vary from half a crown to half a sovereign. The remaining part of the fee necessary to repay the labours of the analyst falls upon the parish, which pays the analyst as a public officer.

This is, however, a minor inconvenience, and one for which circumstances will afford a remedy growing out of the necessities of the case. The considerations which urge the application of this permissive Act to every community are of the most stringent character: they touch nearly the health, honour, and morality of all its members. The City of London has done itself honour in taking the important initiative of adopting the Act. The Corporation have throughout shown an enlightened and honourable appreciation of the public advantages of the measure; for originally it was not intended to apply to the City of London, but the Court of Sewers thought the subject of so much importance that they instructed the Remembrancer to apply that its provisions might be extended to the City. It were greatly to be regretted that this excellent example should not be followed with unanimity throughout the kingdom; but already symptoms of the reaction induced by trade influence are beginning to be felt. It is stated that the Vestry of St. Pancras have for the moment refused to adopt the Act. These gentlemen prefer that the poor should be denied genuine bread, milk, and beer. They reject the application of a scrutiny which health and morality alike demand. We refrain from inquiring narrowly into the reasons which may induce them to shrink from this seemingly obvious public duty, persuaded that the voice of public opinion will so powerfully be heard as to sway their minds to another conclusion. The working of the Act in the City of London will, no doubt, be watched with interest, and taken as a guide by the local authorities of other parts of the metropolis.—*Lancet.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents, we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Enquirer.—We had intended giving the lectures referred to, but have some difficulty in obtaining reports of them.

Sphynx.—To obtain hydrogen gas absolutely pure, it must be evolved from dilute sulphuric and granulated zinc; then transmitted though a long glass tube loosely filled with cotton saturated with a solution of perchloride of mercury; afterwards through a solution of potassa, and finally through concentrated sulphuric acid.

A. R.—It was unintentional. The letter was of course considered private.

Received, with thanks, but too late for insertion in present number—*J. B.—H. N. D.*

Erratum in our last number, p. 202, col. 2, line 7 from bottom, place the comma *before* instead of *after* "nearly."

Books received—*The Chemistry of Calico Printing, Dyeing, and Bleaching—Fresenius's Quantitative Chemical Analysis, 3rd edition.*

Vol. I. of the Chemical News, containing a copious Index, is now ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London, E.C.

CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and R che in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnandon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; R sing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, Baillière, 219 Regent Street, London.

THE CHEMICAL NEWS.

Vol. II. No. 46. — October 20, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Effect of the Presence of Metals and Metalloids upon the Electric Conducting Power of Pure Copper, by A. MATTHIESSEN, *Ph.D. and* M. HOLZMANN, *Ph.D.*

As the electric conducting power of copper varies so much according to different experimenters, we thought it would be of some interest to study the causes of these differences; and on comparing the values found for copper we find that taking silver to equal 100, copper conducts, according to Becquerel, 95·3, Riess 67·2, Lenz 73·4, Davy 91·2, Christie 66·0, Buff 95·4, Pouillet 73·0, Arndsten 98·7. The temperatures at which the above determinations were made are only given in the cases of Becquerel, Lenz, and Arndsten, who compared copper at 0° C. with silver at 0° C. = 100.

The authors prepared pure copper in the following ways:—

1. By precipitating with sulphuretted hydrogen the purest commercial sulphate of copper dissolved in water acidulated with sulphuric acid, dissolving the washed sulphide in nitric acid, and precipitating at a boiling temperature by carbonate of soda in excess, and finally reducing the oxide of copper with pure hydrogen.

2. By precipitating sulphate of copper galvano-plastically by a very weak current.

The diameters of the wires used were about 0·25 to 0·5 millimetres, and the lengths from 0·5 to 1·5 metres; and of each specimen of copper or alloy two or three determinations were made with wires of different diameters.

Twelve determinations were made with pure copper prepared by the authors, and the mean of the results compared with a hard drawn silver wire =100 at 0° C. give 93·08 at 18°·9 for the conducting power of pure copper. All the wires were hard drawn. They also tested the galvano-plastic copper of commerce, and found its conducting power to be the same as that prepared by themselves.

Peltier and others have already observed that annealed copper-wire conducts better than a hard drawn wire, an observation which the experiments of the authors confirm, the difference in favour of the annealed specimens being about 2·5 per cent. The difference in the conductivity of annealed and hard drawn silver wire was still greater.

They next describe the effect of the metalloids and metals on the conducting power of copper.

1. *Effects of Oxygen (Suboxide of Copper).* Copper readily absorbs oxygen from the air when in a fused state; and it is supposed to be present as suboxide, which it retains very obstinately; in fact hydrogen may be led over fused copper in a porcelain tube for hours without completely reducing the suboxide. It is also very difficult to prevent the oxygen being absorbed during casting, &c. In order to prevent these sources of error the authors passed pure hydrogen gas through copper kept in a state of fusion in an atmosphere of carbonic acid. In this manner the suboxide was reduced by degrees; they did not try to determine the amount of suboxide present in copper quantitatively, as no method is known which will give results that can be depended upon.

Copper, chemically purified, fused in contact with air gave as its conducting power 69·37 at 23°·2. The same specimen kept fused for several hours in a porcelain tube in a current of hydrogen conducted 86·35 at 18°·9. The same fused in a tobacco pipe in carbonic acid gas, and having a current of hydrogen passed through the melted mass first for half an hour, and then for three hours, the conducting powers were found to be increased to the following values:—

After half an hour	. .	89·57 at 17°·4
After three hours	. .	93·00 „ 18°·6

Similar results were obtained with galvanoplastical precipitated copper which had been fused in contact with air.

I.	Fused in air	73·32 at 19°·5
II.	The same fused in tobacco pipe as before for half an hour . . .	75·73 „ 17°·7
III.	Fused in pipe for one hour . .	82·70 „ 16°·9
IV.	„ „ for an hour and three quarters	90·68 „ 19°·7
V.	„ „ for three hours . .	92·54 „ 18°·3

The above experiments show how difficult it is to reduce the whole of the suboxide; a fact which explains the reason why no good determinations as to the amount of oxygen present in copper have as yet been obtained.

2. *Effect of Carbon.* According to Karsten copper takes up 0·2 per cent. of carbon; the authors, however, could not obtain wires containing more than 0·05 per cent. This small quantity causes the conducting power to decrease considerably. Galvano-plastic copper in small pieces fused with lamp black gave on analysis 0·05 per cent. of carbon, and the conducting power was found to be 74·91 at 18°·3.

3. *Effects of Phosphorus.* Phosphorus alters the properties of copper to a great extent, it becomes very much harder, and its tenacity is greatly impaired. Of all impurities it has the greatest reducing effect on the conducting power.

Red phosphorus was thrown on melted copper in a tobacco pipe and re-fused. The amount of phosphorus was determined as phosphate of magnesia.

I.	Copper with 2·5 per cent. of phosphorus	7·24 at 17°·5
II.	„ „ 0·95 „ „ „	23·24 „ 22°·1
III.	„ „ 0·13 „ „ „	67·67 „ 20°·1

4. *Effect of Sulphur, Selenium, and Tellurium.* Sulphide of copper does not appear to dissolve in copper, but merely to mix with it mechanically. It makes copper very brittle. The authors succeeded in drawing a wire which contained, according to analysis, 0·18 per cent. of sulphur, but the values obtained as the conducting power did not at all agree with each other. The mean of four determinations gave 88·58 at 19°·4.

Traces of selenium and tellurium make copper so rotten that it cannot be drawn.

5. *Effect of Arsenic.* When arsenic is thrown upon melted copper the greater part of it is absorbed, whilst a part volatilises, and on re-fusing the alloy formed, and if a large quantity of arsenic has been used it has a dingy grey colour, and is very hard and brittle. An alloy containing 5·4 per cent. of arsenic was drawn to the diameter of 0·29 millim.; and if the authors had had drawing plates with finer holes, it might have been drawn much finer, a fact which does not at all agree with assertions lately made, that copper with a small amount of arsenic cannot be drawn into fine wire. The arsenic was determined as arseniate of magnesia. The experiments showed that a trace of arsenic reduces the conducting power of copper to 57·80 at 19°·7.

6. *Effect of heating in current of Ammonia.* It is stated that when copper is heated in ammonia, the gas is decomposed and nitride of copper is found — a fact disputed by Schrötter and disproved by Dick. The authors heated a pure copper wire in dry ammonia for a quarter of an hour, and when cold found its conducting power to be the same, and the wire to be as ductile, as before.

7. *Effect of the Metals.* The electric conductivity of copper is not so much impaired by the presence of small quantities of foreign metals as by that of the metalloids; it is however very considerably diminished by iron and tin.

The authors could not draw a wire of pure copper with only traces of lead in it, for it made the copper to all appearance perfectly rotten. As copper smelters are known to add a small quantity of lead to their copper to soften and render it more tough, 0·1 per cent. of lead was added to copper which had been fused in contact with air, and such a mixture showed a conducting power of 89·48 at 12°·9, owing to the reduction of some of the contained suboxide by the lead.

The general conclusion at which the authors arrive is, that there is no alloy of copper which conducts electricity better than the pure metal.—*Abridged from the Transactions of the Royal Society.*

On the presence of Chlorine in Coal, by Mr. Thomas J. Leadbetter, *Glasgow.*

No attempt has been made, so far as I am aware, to ascertain the quantity of chlorine in coal. The presence of chloride of ammonium among the products of the destructive distillation of coal has been noticed by Fownes and others; and it has also been observed that when the ammoniacal liquor of gas works is concentrated by evaporation, crystals of that salt are deposited. Manufacturers of sulphate of ammonia have likewise found that a notable quantity of combined ammonia remains in the still after the carbonate of ammonia has been distilled off. In a particular sample of this residual liquor from the still, I found 506·4 grains of chlorine per gallon, and in two samples of undistilled ammoniacal liquor I found respectively 156 and 76·4 grains per gallon.

The existence of so large a quantity of chlorine in this ammoniacal liquor, suggested to me that it would be interesting to ascertain the proportion of chlorine in coal, and for this purpose I undertook a series of experiments with various samples of Cannel and other coals obtained from different localities of Scotland. One thousand grains of each sample were boiled in distilled water, and the insoluble portion being filtered off, the chlorine was estimated in the filtrate by nitrate of silver in the usual way. The following table shows the results obtained with the calculations to a ton: —

Name of Coal.	Cl. P.C.	Cl. per Ton.
Lesmahagow . . .	·015292 . .	2383
Boghead. . . .	·012369 . .	2939
Bank Coal . . .	·017300 . .	2712
Knightswood . . .	·019791 . .	3103
Barton's Holm . .	·009277 . .	1454
Monkland . . .	·027831 . .	4363
Thankerton . . .	·004948 . .	775
Soft Coal . . .	·004948 . .	775

It appeared also desirable to test the ash of the above coals for chlorine, and with this view a known weight of the coal was first coked and afterwards ashed in a platinum crucible, and the ash being boiled in water was tested in the usual way for chlorine. In the ash from several of the samples not a trace of chlorine was detected, and in the others only a minute and inappreciable quantity was found. It is therefore evident that when coal is distilled or carbonised in close vessels, the chlorine is expelled with the volatile matters, and this fact affords a satisfactory explanation of the circumstance that no mention is made of the presence of chlorine in the various analyses of the ash of coal published in different chemical works.

In another set of experiments with the same coals, I distilled a portion of each in an iron tube, and carefully tested the distillate for chlorine. In every case I found conclusive evidence of the presence of an appreciabl amount of chlorine.

Laboratory, Andersonian University, Glasgow, 1860.

On the presence of Arsenic and Antimony in the Sources and Beds of Streams and Rivers, by Dugald Campbell.[1]

Having had occasion to examine some "coal pyrites" for arsenic, and finding that element present in rather large quantities, it occurred to the author to see if the sand from the beds of rivers or streams in the districts where this pyrites occurred likewise contained arsenic. On examination arsenic and antimony also were obtained from this sand in notable quantity. So considerable, however, did the amount of arsenic and antimony appear, that it seemed probable that their occurrence was due to other sources besides the coal pyrites, and led to the opinion that these metals would be found in the sand from the sources or beds of most streams or rivers in greater or less quantity depending upon the geological formation from which such sand had its origin. After several experiments the author found that his views were confirmed in this respect, and in every specimen of sand from these sources which has been hitherto examined he has obtained arsenic and sometimes antimony. The arsenic in some instances being in considerable, in others in small, quantity, but in no instance being so small as to render its presence doubtful.

The process adopted for the detection of the arsenic is as follows:—the sand is first dried by means of a sand bath at not too high a temperature, and sifted if necessary through a coarse seive to remove anything larger than sand. The portion for experiment is then weighed out; more than two ounces of the dry sifted sand being seldom

[1] Abstract of a paper communicated by the author to the *Philosophical Magazine* for October 1860.

required. It is then ascertained that the hydrochloric acid is free from arsenic (or rather how far it is contaminated with it, for it is rarely indeed that this acid is found entirely free from arsenic), which is done by introducing into a drachm of the acid diluted with about three drachms of distilled water when brought to boil in a small flat bottomed flask, about the eighth of a square inch of bright copper foil specially prepared as free from arsenic asit is possible to be obtained, and gently boiling the same from about half an hour to three quarters or so, avoiding much evaporation by having a small funnel in the mouth of the flask. Should this piece of copper get coated with arsenic, it is taken out and replaced by a similar piece, which is boiled in like manner. Should this piece of copper likewise get coated, the acid is rejected as too impure; but if no coating has taken place, or only one piece is coated, half an ounce of the acid is measured out into a small flat bottomed flask capable of holding about three liquid ounces, and two ounces of the dry sifted sand are gradually added. The bottle is now closed with a cork, and is allowed to stand for some hours until the acid has thoroughly penetrated the sand, when the cork is removed and a perforated cork inserted, attached to a bent tube about three feet long leading into a receiver through a cork a little loose at first, but capable of being made tight afterwards. The receiver is placed in water and heat applied by means of a sand bath, gently at first, but gradually increasing when the cork of the receiver is made to fit tight. Wet rags or bibulous paper are applied down the tube, and in about an hour the greater part of the distillate will have passed into the receiver, when it may be detached.

The copper test is the one generally applied first, in exactly the same manner as above described, only employing less acid. After one piece of copper is coated, it is withdrawn and another substituted, and so on until no more coating takes place. The liquid lost by evaporation is made up from time to time by addition of distilled water. The remainder of the distillate may be tested by a Marsh apparatus.

The metallic arsenic deposited from the distillate from two ounces of sand is in many instances of sufficient quantity to dissolve or sublime and examine by other tests.

The sands examined have been selected with much care, and in most cases, when taken from the beds of streams or rivers, they have been taken above where they could receive contamination from coal pits or works, or from any other source.

Dr. Campbell concludes his paper by saying: —

"Although in my experiments I have not yet met with a sand from the source or bed of a stream or river that does not contain arsenic and perhaps antimony also, yet judging from the exceeding variability in the quantity in each, I am far from thinking that sands will not be found, though I should say they will be few in number, that will not contain these metals."

[Mr. Campbell admits that the chemicals he employed contained arsenic to start with. We think it would have been as well to have repeated these experiments with pure reagents before recording as a fact such a wholesale distribution of this poison. The great importance of these inquiries demands that every resource of modern chemical skill should be called in aid of the experimentalist. In all such cases the materials employed should be like Cæsar's wife "above suspicion."—Ed.]

TECHNICAL CHEMISTRY.

On a New Purple and on a Blue Dye soluble in Alcohol, by C. Greville Williams.

Chemists familiar with dyes and pigments are aware that great efforts have lately been made to form purples by the addition of a blue to the new red colours known as magenta, fuchsine, &c. A certain amount of success has been obtained by printing carmine of indigo along with magenta red upon woollen fabrics. But this process has of necessity received a very limited application, owing to the impossibility of rendering the indigo soluble in the same menstruum as the magenta. In fact, there is no blue dye or pigment soluble in alcohol known to technical chemists. Such a substance, which has been for some time vainly sought, I have at last succeeded in obtaining in large quantities from cinchonine, or rather from the chinoline which is procured by distilling the former alkaloid with caustic soda or potash. The process is, in its main features, the same as that by which I demonstrated a specific difference to exist between the chinoline from coal tar and that obtained by the process just alluded to.[1] I have however greatly improved the process, so as to reduce its cost to a minimum, and bring it within the reach of commercial enterprise. Cinchonine being a waste product, has in some quinine manufactories accumulated to the extent of tons, and so long as its price does not exceed 8*s.* or 10*s.* per pound, it can with profit be employed in producing blue and purple dyes.

The quantity of crude chinoline yielded is much greater than is generally supposed, and moreover the amount of dye procurable is very great. This arises from the fact that in addition to chinoline, amyle enters into the compound, and we thus take advantage of its high atomic weight.[2] It might be urged that iodide of amyle is far too expensive a reagent to be employed with success in any commercial operation. To this it may be answered that fusel oil is procurable for 1*s.* 6*d.* per gallon, and iodine can now be purchased in quantity for 8*s.* and phosphorous for 2*s.* 6*d.* or 3*s.* per pound. If, therefore, a plan could be devised by which the iodine might be recovered, the entire process would acquire a practical character. Now the recovery of the iodine is easy if we follow the second method of preparation given below; moreover the sulphate and chloride of amyle will probably ere long be substituted for the comparatively costly iodide.

In order to procure the blue colour, one part by weight of chinoline is to be boiled for ten minutes with one and a half parts of iodide of amyl. The mixture from being straw-coloured becomes deep reddish brown, and solidifies on cooling to a mass of crystals. This product of the reaction is to be boiled for ten minutes with about six parts of water, and, when dissolved, filtered through paper. The filtered liquid is to be gently boiled in an enamelled iron pan over a small fire, and excess of ammonia gradually added. The ebullition may be prolonged with advantage for one hour, the evaporation of the liquid being compensated for by the gradual addition of weak solution of ammonia. The latter may be prepared by the admixture of equal volumes of ammonia of the density 0·880 and distilled water. The hour having elapsed the whole is allowed to cool, when the colour will almost entirely have precipitated, leaving the supernatant liquid nearly colourless. On pouring the fluid away (preferably through a filter, in order to retain float-

[1] *On Isomeric Alkaloids*, Chemical News, vol. i. p. 15.
[2] $C_{10}H_{11}=71$.

ing particles of colour) the dish will be found to contain resinous looking masses which dissolve readily in alcohol, yielding a rich purplish-blue solution which may be filtered and kept for use.

The colour prepared as above is, as has been said, of a purplish tint, but if a purer blue be required the following modification is to be resorted to. The filtered aqueous solution of hydriodate of amyle-chinoline, is, as before, to be brought to the boiling temperature, but instead of adding ammonia, a solution of caustic potash containing about one-fifth of its weight of solid potash is to be substituted. The addition is to be continued at intervals until three-fourths as much potash has been added as is equivalent to the iodine in the iodide of amyle used. The fluid may, after a quarter of an hour's ebullition, be filtered to separate the resinous colour. The product is a gorgeous blue with scarcely any shade of red. On adding the other fourth of potash to the filtrate while gently boiling, a black mass will be precipitated containing all the red, which otherwise would have been mixed with the blue. This mass dissolves readily in alcohol, yielding a rich purple solution containing, however, an excess of red. The alcoholic solution on filtration leaves on the filter a dark mass soluble in benzole, and as sometimes prepared, affording a brilliant emerald green solution of great beauty. It is not always easy to obtain this green colour. I have never on any occasion, however, seen a failure in preparing the blue or purple.

With regard to the economy of the process, the following is a near approximation to the produce in my later experiments. Cinchonine, distilled with excess of caustic soda, affords 65 per cent. of crude chinoline, containing in addition to that base lepidine, cryptidine, and at least two more as yet unknown homologues of chinoline, besides pyrrol and a number of bases isomeric with the pyridine series. The water that comes over in the distillation contains ammonia, and the more soluble of the latter class. All the distillate which on rectification distils above 390° or 408°F. up to the highest range of the mercurial thermometer, is suitable for preparing the colour.

One part of the mixture of bases above alluded to and one and a half parts of iodide of amyle yield 23 parts of blue dye containing four per cent. of solid colouring matter. One volume of magenta pink, of the ordinary strength found in commerce, and two volumes of the chinoline blue, form a fine purple inclining to the blue shade. The proportion of magenta may, in many cases, be increased with advantage. The colour on wool or silk stands soap well.

Production of Valuable Manure from the Air, by MM. Margueritte *and* De Sourdeval.

The value of guano and most other concentrated manures consists to a considerable extent of the ammonia which they contain. As three quarters of the atmospheric air consists of nitrogen, and as hydrogen forms one ninth of all pure water, if some cheap means could be found for inducing the hydrogen of water to enter into combination with the nitrogen of the air in the form of ammonia, this valuable manure could be produced in unlimited quantities, and the agricultural products of the world enormously increased. The efforts to do this have been, at last, crowned with success, as will be seen by the following abstract of some recent continental researches.

Since the remarkable labours of Messrs. Liebig, Schaltenmann and Kuhlmann, on the fertilising action of ammoniacal salts, the production of ammonia at a low price has become a problem of the highest interest to agriculture. But to arrive at this result it is necessary to obtain the nitrogen elsewhere than in the nitrogeneous matters; which may, for the most part, be employed directly as manures, and of which the limited quantities and elevated price permits in any event only restricted and costly manufacture.

Atmospheric air is an inexhaustible and gratuitous source of nitrogen. However, this element presents so great an indifference in its chemical reactions, that, notwithstanding the numerous attempts which have been made, chemists have not heretofore succeeded in combining it with hydrogen so as to produce ammonia, artificially. This result, so long desired, has been reserved for MM. Margueritte and De Sourdeval, who have obtained it by employing an agent of which the remarkable properties and neat and precise reactions have permitted them to succeed where all others had failed. This agent is baryta, of which notice has recently been taken on account of the recent applications that M. Kuhlmann has made of it in painting, but of which no person suspected the part that it was to be called to play in the development of the agricultural riches of our country. The manufacture of ammonia is based on a fact entirely new, the cyanuration of barium. It had been believed until the present time that potash and soda alone had the property of determining the formation of cyanogen; that the earthy alkaline bases — baryta, for example, could not, in any case, form cyanides.

Messrs. Margueritte and De Sourdeval have ascertained that this opinion is entirely erroneous, and that baryta, much better than potash or soda, fixes the nitrogen of the air or of animal matters in considerable proportions. It is already understood that, for the preparation of Prussian blue, the cyanide of barium presents great advantages over that of potassium, for the equivalent of baryta costs only about the one seventh of that of potash. Thus do we find practically and really obtained the result first announced by Desfosses and vainly pursued in France and England, the manufacture of cyanides from the nitrogen of the atmospheric air. This solution, so important, depends on the essential difference which exists between the properties of baryta and those of potash; the first is infusible, fixed, porous, and becomes deeply cyanuretted without loss; the second is fusible, volatile, and becomes cyanuretted only at the surface, and suffers by volatilisation a loss which amounts to 50 per cent. After the cyanide of barium was obtained, the grand problem for Messrs. Margueritte and De Sourdeval to resolve was the transformation of the cyanide into ammonia by means at the same time simple, rapid, and inexpensive. The following is the operation: —

In an earthern retort is calcined, at an elevated and sustained temperature, a mixture of carbonate of baryta, iron filings in the proportion of about 30 per cent., the refuse of coal tar, and sawdust. This produces a reduction to the state of anhydrous baryta, of the greater part of the carbonate employed. Afterwards is slowly passed a current of air across the porous mass, the oxygen of which is converted into carbonic oxide by its passage over a column of incandescent charcoal, while its nitrogen, in presence of the charcoal and of the barium, transforms itself into cyanogen and produces considerable quantities of cyanide. In effect, the matter sheltered from the air and cooled, and washed with boiling water, gives with the salts of iron an abundant precipitate of Prussian blue. The mixture thus calcined and

cyanuretted is received into a cylinder of either cast or wrought iron, which serves both as an extinguisher and as an apparatus for the transformation of the cyanuret. Through this cylinder, at a temperature less than 300° (Centigrade) is passed a current of steam, which disengages, under the form of ammonia, all the nitrogen contained in the cyanide of barium. It is impossible to foresee all the results of this great discovery. Among other things, it suggests the production of nitric acid from the air by oxidising ammonia.

On the Preparation of Artificial Colouring Matters with the Products extracted from Coal Tar, by M. E. Kopp.

(*Continued from page* 197.)

3. *Reduction of Nitrobenzole by Ferrous Acetate.* Ferrous acetate reacts on nitrobenzole and converts it into aniline, while the sulphate, chloride, and oxalate of iron have no action on it. The reaction is represented by the formula —

$$C_{12}H_5NO_4 + 12FeO + 2HO + \bar{A} = 6Fe_2O_3 + C_{12}H_7N + \bar{A}$$

One part of nitrobenzole is placed in a retort with an aqueous solution of acetate of iron. The retort is then heated over a water-bath for several hours, and then the contents are filtered — being diluted with water if they have become pasty. The residue left on the filter, which is principally hydrated peroxide of iron, is washed with boiling water. The filtrate and washings are then distilled, the condensed products being water, acetic acid, and acetate of aniline. These may be again distilled with strong sulphuric acid (using four-tenths the weight of the nitrobenzole employed) to recover the acetic acid and form sulphate of aniline, and the latter may be decomposed by caustic potash and the aniline distilled off. This process has not been found advantageous, and has consequently been given up.

4. *Reduction of Nitrobenzole by means of Arsenite of Potash or Soda.* This process was invented by Wöhler. He digested nitrobenzole with a solution of arsenious acid in a strong ley of caustic soda, or placed the arsenical solution in a tubulated retort, heated it to the boiling point, and then allowed the nitrobenzole to fall in drop by drop. Under these circumstances nitrobenzole is transformed into aniline which distils over, and it is only necessary to saturate with an alcoholic solution of oxalic acid to obtain perfectly pure oxalate of aniline.

The last method of forming aniline we shall quote is that of Schlagdenhausen, who has shown that it is produced when nitrobenzole and sulphide of carbon are heated together in a sealed tube to 160°.

Properties of Aniline.[1] — Aniline when pure is a colourless liquid, very astringent, having an aromatic odour, and an acrid burning taste. It is slightly soluble in water, and very soluble in alcohol and ether. Its sp. gr. = 1·028; at −20° it does not freeze. It boils at 182°, and distils unchanged. When warmed it dissolves sulphur and phosphorus. It is a powerful base combining with acids to form salts, which in general are soluble. It decomposes ferrous and ferric salts, and the salts of zinc and alumina precipitating from them the metallic oxides. It also precipitates the chlorides of mercury, platinum, gold, and palladium; but it does not precipitate the nitrates of mercury and silver.

Aniline easily oxidises, turning yellow in water, and in time becoming resinified.

When aniline dissolved in hydrochloric acid is acted on by chlorine the solution takes a violet colour, and on continuing the current of chlorine the liquid becomes turbid, and deposits a brown-coloured resinoid mass. On submitting the whole to distillation vapours of trichloraniline and trichlorophenic acid pass over.

A solution of the alkaline hypochlorites colours aniline a violet blue, which passes rapidly to a pale red, especially in contact with acids.

A mixture of hydrochloric acid and chlorate of potash act on aniline, the final result of the action being chloranile $C_{12}Cl_4O_4$, but in the course of the reaction several coloured intermediary bodies are formed.[2]

If a solution of chlorate of potash in hydrochloric acid be added to a solution of a salt of aniline mixed with an equal volume of alcohol, and care is taken to avoid an excess of the hydrochloric solution, a flocculent precipitate is deposited after a time of a beautiful indigo blue; this precipitate filtered and washed with alcohol contracts strongly, and the blue colour passes to a deep green. The filtered liquid has a brownish-red colour; on boiling it, adding fresh quantities of hydrochloric acid, and chlorate of potash, a yellow liquor is obtained which deposits crystallised scales of chloranile.

An aqueous solution of chromic acid gives with solutions of aniline a green, blue or black precipitate according to the concentration of the liquors.

When a small quantity of an aniline salt is mixed in a porcelain dish with a few drops of strong sulphuric acid, and a drop of a solution of bichromate of potash is allowed to fall on the mixture, a beautiful blue colour appears after some minutes, which, however, soon disappears.

Dilute nitric acid combines with aniline without altering it immediately; but after some time nitrate of aniline crystallises in the form of concentric needles, the mother liquor turns red coloured, and the sides of the capsule becoming covered with a beautiful blue efflorescence. When a few drops of strong fuming nitric acid are poured upon aniline it is immediately coloured a deep blue; on applying heat the blue tint quickly passes to yellow, a lively reaction is manifested, which results in the formation of picric or trinitrophenisic acid.

Potassium dissolves in aniline, disengaging hydrogen, whilst the whole becomes a violet coloured pap.

The other reactions of aniline, which are characterised by the formation of anileine, fuchsine, azaleine, will be related in a future number, when describing the processes for the preparation of these substances. But before commencing these we may just glance at some of the properties and derivatives of binitrobenzole.

Binitrobenzole, as before stated, is formed when nitrobenzole is added drop by drop to a mixture of equal parts of fuming nitric acid and sulphuric acid as long as the liquids will mix. If such a mixture be boiled for a few minutes it becomes on cooling a thick magna of binitrobenzole, which is easily purified by repeated washings with water. A single crystallisation from alcohol will furnish the body in long brilliant prisms which melt at a temperature above 100°, and crystallise again on cooling in a radiated mass.

Binitrobenzole is very soluble in warm alcohol. When a plate of zinc well cleaned is placed in a cold alcoholic solution of binitrobenzole and a hydrochloric acid is added by degrees, we observe that the disengagement of hydrogen, which at first takes place, soon ceases, and at the same time the liquid gradually takes a crimson-red tint.[3] The reaction being completed, the excess of zinc

[1] Gerhardt, *Chimie Organ.* iii. p. 84.

[2] See Chem. News, vol. ii. p. 195.

[3] Church and Perkin, *Quart. Journ. Chem. Soc.* ix. p. 1.

is removed and the liquor is saturated by an alkali, which precipitates the oxide of zinc coloured a deep purple. The precipitate is collected on a filter and washed with alcohol. By distilling the highly coloured alcoholic washings, washing the residue with cold water, then redissolving it in alcohol and evaporating it afresh to dryness, the new matter is obtained perfectly pure. The authors have given it the name of nitrosophenyline. It has the formula $C_{12}H_6N_2O_2$. When obtained as above, it is a black shining substance; when heated, it fuses and decomposes directly; it is almost insoluble in water, but freely soluble in alcohol and acids. An alcoholic solution containing only 0·2 per cent. is so deeply coloured that by reflected light the solution seems opaque and of an orange red.

Concentrated hydrochloric acid and dilute sulphuric and nitric acids form magnificent crimson red solutions with nitrosophenyline, which is precipitated from them again unchanged by alkalies.

Binitrobenzole treated with an alcoholic solution of sulphide of ammonium is at first converted into nitraniline,—

$$C_{12}H_6(NO)_4N = C_{12}H_6N_2O_4$$

that is to say aniline, in which one equivalent of hydrogen is replaced by one of nitrous vapour. Nitraniline crystallises in yellow needles which stain the epidermis like picric acid.

PHARMACY, TOXICOLOGY, &c.

Shipment of Chemicals.—Caution to Wholesale Druggists. A CASE of great importance to wholesale druggists and the shippers of chemicals was decided by the Lord Mayor on October 11. A merchant in the City sent on board of one of the Peninsular and Oriental Steam Company's boats, the *Pera*, four packages, the contents of which were described in the shipping declaration by the usual phrase, "apothecaries' wares." The second officer of the ship noticed that one of the cases leaked, and he observed a strong odour of spirit. He reported the circumstance, and the cases were taken on shore and opened, when it turned out that two of them contained stone bottles holding spirits of nitric ether and sulphuric ether. This being reported to the directors of the company, they ordered proceedings to be taken under the 329th section of the Merchant Shipping Act, which enacts that any person who shall cause any explosive or dangerous material to be shipped on board of any vessel without marking the nature of the same upon the package, or giving notice to the master or owners of the vessel of the nature of the materials so sent on board, shall be liable to a penalty of 100*l.*

To prove the dangerous nature of the articles Dr. Letheby was called, who deposed that spirits of nitric ether was a mixture of alcohol and hyponitrous ether—the latter being an extremely volatile and inflammable liquid which boiled at 70°. In case of leakage the mixture of the vapour and atmospheric air would form a highly explosive and dangerous compound. The inflammability of the vapour too was excessive, which the Doctor illustrated in court by putting a lighted lucifer match to the mouth of a vial having a few drops at the bottom. Sulphuric ether was equally dangerous, though hardly so volatile as hyponitrous ether. Dr. Letheby concluded his evidence by stating that from his scientific knowledge of the articles in question, he should say that it was highly dangerous to place them on board ship without taking proper precautions to have them safely secured.

For the defendant several persons were called who proved that the bottles were well packed, and that it was usual to send ethers to India in similar cases. Mr. Warrington, of Apothecaries' Hall, said that with ordinary care the goods might have gone safely to India; but of course if any leakage took place it would have been highly dangerous. Mr. John Wyman was called to prove the way ether was generally packed, but his evidence was not received. In answer to a question from the counsel this gentleman stated that until he heard the evidence of Dr. Letheby he was not aware that ether was of so dangerous a nature.

This having closed the case on both sides,

The Lord Mayor at once said he was clearly of opinion that the 329th section of the Act of Parliament in question had been violated, and the evidence of Dr. Letheby fully corroborated his own opinion, that the articles that had been shipped on board this vessel by the defendant were of a highly inflammable and dangerous nature, and it was fearful to imagine the consequences that might have resulted from their being taken on board. He had no wish to prejudice the case in any manner, or to make it stronger than it really was, but he could not help taking into consideration the dreadful consequences that might have resulted from the act of the defendant, and he felt that he was bound to inflict a penalty. In the hope that the publicity that would be given to the proceedings would have the effect of preventing the recurrence of a similar act, he said that he should mitigate the fine from 100*l.* to 10*l.* and he hoped that this would have the effect to which he had adverted, which he was sure was the only feeling that had influenced the parties by whom the proceedings had been instituted.

On the Antagonism which exists between Strychnine and Curara, by M. VELLA.[1]

IN order, finally, to clear up the mystery which envelopes this subject, the author has made for the last few years a great number of experiments (97), which he has grouped under two heads: 1stly, those in which the animals, poisoned by the introduction of strychnine into the stomach, received through the medium of the blood successive doses of curara as soon as the tetanic spasms became manifest, with the effect of neutralising completely the toxical action of the former poison, and consequently causing almost perfect relief. 2ndly, those in which he injected into the blood a mixture of strychnine and curara which remained completely inert; while another animal, placed under the same circumstances, died under the influence of the same dose of strychnine when unmixed. Finally, in order to verify these experiments, he allowed the animals which had resisted the action of the strychnia neutralised by the curara, to remain quiet for some days, and having placed them as much as possible under the same physiological circumstances as before, he administered to them a dose of strychnine the same as that employed in the first experiment, but without mixture with curara, and with the uniform result of the rapid death of the animal.

M. Vella recommends the use of successive very weak doses of curara, for if it was desired to arrest the tetanic attack, even in the act of injection, the animal might succumb to the action of the curara. When the convul-

[1] *Comptes-Rendus*, t. lx.

sions are diminished in intensity, it is necessary to cease the injection of the curara, being, however, constantly ready to recommence when they reappear. From these numerous experiments, the author thinks himself authorised to conclude that curara can completely destroy the effects of a dose of strychnine, which would be mortal if injected alone either into the stomach or the veins. There is consequently an antagonism between the two poisons, and this is clearly demonstrated by the fact, that by mixing the curara with the strychnia, far from increasing the poisonous effects of that substance, we completely neutralise them, and the conclusion which we are therefore justified in arriving at is, that curara is the true physiological antidote for strychnine.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. ANSTED, *M.A. F.R.S.*

LECTURE VII. *The Action of Water in its Circulation through the Earth.*

I BELIEVE it is impossible to exaggerate the importance of water in the economy of the world, whether on the earth's surface or in the atmosphere, or within the surface where it is rarely seen. All are familiar with it in the former—few think much about it in the latter position. We recognise the value of the ocean and the river, of the cloud and the rain; but we hardly trouble ourselves to trace the water that passes into the earth's crust, or consider the part it plays in solid matter, where it is rarely seen and little known.

I speak of water just as we all meet with it—fresh water as it comes from the spring, sometimes cold, sometimes boiling; salt water as it exists in the ocean; vapour of water as it is seen in the cloud; rain water as it falls from the clouds, and runs over the land in brooks and rivers, or collects in pools and lakes; crystallised water as it rests as snow on the lofty mountain top; solid water as it creeps down a glacier through the sheltered valley, or floats away—an iceberg—from the polar land. In all conditions it is essentially the same.

But although I connect no new idea with the name, its meaning lies deeper, and its uses and operations extend further than we sometimes suspect. Before speaking, however, of the circulation of water in the earth, which is the object of this lecture, I must remind you briefly of what the nature and properties are of the substance we have to deal with.

Water is composed of one volume of oxygen and two of hydrogen gas, which require for their combination the passage of an electric spark, and when decomposed by passing steam over red-hot iron the reduction of water into its elements is also accompanied by electric action. It exists in nature in the three states of solid, liquid, and gaseous, all of them represented within the ordinary limits of temperature at the earth's surface, inasmuch as the poles of the earth are occupied by ice, and in the atmosphere a large quantity of aqueous vapours is always present. It attains its minimum density at about 40° Fah.—in the state of water—expanding slightly as it enters the solid state. It is an almost universal solvent, and it is a conductor of electricity.

I need do no more than remind you that owing to the nature and constitution, and the movements of our atmosphere and its relation to water, a very large quantity of water is lifted from the sea, passes after a time into cloud, and coming over land is dropped there as rain. Of this a certain proportion enters the earth, and my next object is to show what then becomes of it.

To do this I must explain the material it enters, and the way it enters.

The various rocks with which water has to deal are (1) sandstones of various kinds, including loose sand, (2) limestones, chalk, and marbles, (3) clays, (4) slates and schists, (5) granites, and (6) basalts. Of these almost all were originally both formed and deposited by water, and even these, whose aqueous origin is doubtful, may originally have had relations with water, although they have since become greatly altered. It is only basalts that are the direct results of igneous fusion. All these rocks have been dried, and most of them exposed to uniform moderate temperature for a long time under great pressure, during which time electrical and magnetic currents were constantly passing through them, and chemical forces exerting their influence.

All stones contain water; even the driest and most compact marbles, in their driest state, hold from ·4 to 1·4 per cent. while some clays consist of as much as 25 per cent. or one-fourth of their weight in water. The water is contained in two ways; either mechanically, having been absorbed, and capable of being evaporated, or chemically combined, so that it cannot be got rid of by the application of heat short of decomposition. The quantity of water contained mechanically may either circulate freely between the particles or remain as an essential ingredient far away from surface influences. The circulation through the rock is either by open crevices or by capillary ducts, and in any case the water that enters from above, and is then mechanical in its action, may, as it passes into the substance of the rock far out of sight, enter into new chemical combinations.

Now, since rocks have been either deposited from water, and remain unaltered, or have been modified by long exposure to the temperature and forces constantly brought to bear upon them in the earth, we have as the result the formation of various groups, which we may proceed to describe. All of them contain water, which in some cases is present in abundance, mechanically; but in others can only be discovered by chemical decomposition, entering into the rock as a hydrate; while in others it can be made out by aid of the microscope, occupying cavities, sometimes extremely minute, which are even found in the most compact crystals. It has been determined that in the ordinary mechanically formed rocks, which abound with crystals, and many of which are semi-crystalline, all the cavities of the crystals contain water, whereas of the volcanic rocks the cavities of those cooled at high temperature near the surface are filled with some glass, and of these volcanic and other rocks, called igneous, cooled or formed at great depth, and under great pressure, the cavities are partly filled with fluid, which consists chiefly of water. It is also determined that the bubbles or cavities in such rocks and crystals are large in proportion as the temperature and pressure under which they were formed were great, while the cavities themselves are numerous in proportion to the rapidity of crystallisation. On the other hand, crystals are clear and transparent in proportion to the slowness of crystallisation.

Of the different rocks, sandstones contain a very variable quantity of water; a good kind, such as the Red Mansfield, which weighs 150 lb. to the cube foot, containing in that space about five pints; and the Darley Dale, also a good stone, about four pints of water. These are the quantities present in the dry stone, and to illustrate more fully the quantity of water thus involved as present in the earth, let us assume an area 10 miles square to a depth of 100 yards as occupied by such rock. The quantity of water in this mass of the first stone named would be about 5,000,000,000 and in the other about 4,000,000,000 of gallons, which would fill a reservoir occupying 1000 acres to a depth of 10 feet.

The lower kind of sandstones and sands contain far more, but the total quantity of water in the space of common sea sand designated above, when in its ordinary state of wetness beneath the earth, would be double that in the stone. If there are 100 square miles of such sands 100 yards deep, and therefore capable of containing about 300,000,000,000

of gallons, we may obtain from each square mile only 1,000,000 gallons, or one three thousandth part per day by an exhaustive system of pumping.

Of the limestones the least absorbent holds as much water as the Darley Dale sandstone, while a cubic foot of Bath stone absorbs double that quantity, and some of the more porous magnesian limestones as much as 12 pints.

There are thus many common building stones of which each square yard of surface exposed can suck in as much as *nine gallons* for every foot of thickness, and some that can actually absorb between 13 and 14 gallons.

An area of such stone such as alluded to before, 100 square miles and 100 yards deep, would when saturated contain water that would fill a reservoir of 3500 acres, 10 feet deep.

Chalk, however, is much more absorbent still; the cube foot absorbs 2 gallons, and the area mentioned would hold water for a reservoir 6000 acres 10 feet deep.

Clays often consist of 10 per cent. water; but when quite dry and least absorbent, they always contain from 6 to 8 per cent., and this proportion also is found in shales and schists.

Other rocks as seen at the surface contain from 5 to 15 parts in 1000 of water, and as 1 part in 1000 is equivalent to half a gallon water in a cube yard, the 100 square miles and 100 feet deep would contain water enough to fill a reservoir of 56 acres 10 ft. deep. Half this may be regarded as the smallest proportion present in rocks of any kind.

Taking then the rocks that we find on the earth's surface, we may say that very few indeed do not contain when in their ordinary state, and when we call them perfectly dry, at least 2 pints of water in every cubic yard, while all rocks that we call absorbent usually contain at least a gallon when driest, and are capable of absorbing without being overcharged from 10 to 50 gallons in the same volume; and as a gallon of water weighs 10 lbs. and a stone of such kind something less than 2 tons, we may perceive the relation.

Each ton of stone contains never less than a pint and may contain 25 gallons (more than 2 cwt.) of water. And although never drained entirely the proportion may vary very greatly.

Water is therefore present in rocks in such great abundance, that under every square mile of surface the quantity that exists between that surface and a depth of say a thousand yards is enormously large — varying from a sheet half a yard deep to a depth of as much as a hundred yards according to the rock.

It is hardly necessary to remind you that no masses of rocks are perfectly uniform in their condition for any distance, while it is equally notorious that the temperature of the earth's interior increases with the depth, and evaporation constantly goes on at the surface, except when rain is falling and the surface is becoming saturated. The water that falls on the surface is not pure, and is generally loaded with various salts and acids before it reaches even a small distance in the interior. As it descends it occupies any cavities that may exist in the rock, and that such cavities not only exist but are very numerous is well known by actual observation.

When, however, the cavities are full, or the fissure by which the water enters communicates with a distant outlet, springs occur. These generally convey a certain quantity of saline matter absorbed in passing through the earth, and often modified or removed when the water issues. The water in passing through the deeper rocks is also heated, and this heated water is especially active in absorbing, dissolving, and depositing foreign matter.

It is in this process that crystals and all semicrystalline minerals are produced, and during these changes, water, not being able to escape, becomes as it were entangled whenever the pressure is not too great to prevent it. Cavities, however, are always formed, and in some cases these are large and manifest, in others only made out with difficulty. Thus in salt there are often large cavities visible to the eye containing water and mud, and these crystals have been formed at ordinary temperatures and at no great depth. Calc spar and quartz also generally contain numerous cavities, but the latter, when perfectly clear, is almost free. Felspar abounds with them, and the water in felspar is chiefly contained in this way.

The water in the cavities of crystals contains salts of potash, soda and lime and the size of the bubble compared with that of the cavity marks the temperature and pressure at which the fluid was introduced.

Granite being formed of mixed crystals, many if not all of which must have been associated with water, must be regarded as an igneous rock only in a very limited sense, and is due probably quite as much to the modifications introduced by water agency as to the heat accompanying it. Being formed also at great depth, and therefore under great pressure, the water remains in and forms part of the solid rock. The different granites contain water cavities of different size, and these must have been formed larger and numerous or smaller and fewer as the rock was formed rapidly or slowly. Thus the coarse-grained veins are full of cavities which are generally large, while fine-grained solid granite contains but few and these are small.

Thus we can tell under what pressure and temperature, and with what rapidity the rocks were formed, and can understand that in some cases the material filling up crevices is fine and in others coarse.

Let me now bring together the general results of this discussion, and endeavour to put before you in a few concluding words the use and influence of water in the interior of the earth. Although not itself a simple substance, water is a compound of which the composing elements possess affinities so powerful, that the agency of electricity appears to be involved both in its formation and decomposition. The conversion or production of water involves electricity, heat, and force, and this conversion is always going on; for water is everywhere present—no known or conceivable conditions of matter, consistent with the presence of more than very small quantities, appear to be free from it, hardly any combinations of simple substances being altogether without water, and no large quantities of simple substances existing on or near the earth's surface.

Water then absorbs everything and is absorbed by everything. Itself a liquid, it enters into the composition of almost all solids, almost as an essential to solidity. As a solid it has its own special value and properties. In the shape of steam it represents power, not only for man's machinery, but in the workshop of nature. In every condition and at every change it is largely connected with heat and electricity. It enters also into the composition of every solid and fluid of which each part of every living thing is formed.

Let us trace its course from its great receptacle the ocean, where it occupies and conceals depressions, which are indeed little more than wrinkled or furrowed markings on the earth, and which if they could be seen from our satellite the moon, must appear very small compared with the variations of level on that body.

Kept in incessant motion in all parts of the ocean by tidal influences and winds, water rising as vapour from its surface is distributed between the particles of mixed gases that form our atmosphere and there becomes subject to influences of temperature and electricity, and these are constantly changing by the revolution of the earth on its axis, of the moon round the earth, of the earth and moon round the sun, and of our whole system in space.

Lifted as vapour it is drifted along either in an invisible or visible form, until it reaches land. Once there it is set free, and large quantities fall to the earth. Part of what falls is re-evaporated, part serves to quench the thirst of every leaf and root, as well as every mouth and skin exposed to its influence, part again runs on the surface — the mountain torrent, the brook and the river, carrying back this proportion to the parent ocean. Part of it whitens the lofty mountain top or collects in icy masses in the sheltered valleys. But a large part enters the earth, and of this we

have been principally speaking to-day. The earth and the sands are thirsty, as well as the leaf and the skin; they also drink in an abundant supply, but they convey downwards some portion, and this reaches the interior through the crevices of hard rocks, or the porous substance of those that are softer.

This supply is so ample that abundant springs gush out from the hill sides, or are ever ready to rise through openings prepared for them by nature or man. But the ultimate residuum when all this lavish supply has been granted is still an important quantity.

(To be continued.)

NOTICES OF BOOKS, PATENTS, &c.

Ure's Dictionary of Arts, Manufactures, and Mines: new Edition, chiefly rewritten, and greatly enlarged. Edited by Robert Hunt, *F.R.S. F.S.S.* &c. &c. Part XII. London: Longman & Co. October 1860.

Ure's Dictionary has been, ever since its first publication, the principal work of reference on the subjects of which it treats. Any one wishing to know something of the practical details of an art or manufacture first consults it; and inventors with a new idea generally refer to Ure before they take the trouble to go through the more prolix details of the Patent Office. It is very important, therefore, that such a work, in order to maintain its reputation, should be kept well up with the times. It is the misfortune of all dictionaries and encyclopædias of science, as we not long ago had occasion to remark, that in these days of progress they should quickly become out of date, requiring either extensive additions in the way of supplements, as also entirely new editions.

A new edition of Ure's Dictionary has long been wanted; and we are bound to say that editor and publishers seem to have done their best to make this worthy of the reputation of the work. In general (we speak of the present part—the only one we have had the opportunity of consulting) we are able to give our almost unqualified approbation to the work. As a matter of course, it has its deficiencies, some of which we shall presently point out; but these are mainly, as we have hinted, the consequences of the rapid progress of science, and scarcely the faults of the editor and writers.

The part we now notice includes the greater portion of the articles under the letter P, extending from "Ores" to "Printing." On turning to the different articles, we notice particularly that on platinum as an illustration of the remark we have made above, for we observe that no reference is made to the now hardly recent researches of Deville on this metal. The Chemical News of the latter part of the past year gave a detailed account of Deville's furnace and method of working platinum, and we think it might be reasonably expected that a work issued this month should include some account of this process.

The article on Potash, again, makes no mention of the different processes which have been invented and patented for extracting that alkali from felspar and other minerals.

In that on Vegetable Parchment, no reference is made to the invention of Mr. Taylor, who has patented the use of a strong solution of chloride of zinc for strengthening paper and converting it into a similar substance to that Mr. Gaine makes by the use of sulphuric acid.

These, perhaps, are unavoidable deficiencies; and we gladly turn to some of the entirely new matter in this edition, to show that the editor has endeavoured to supply the best information procurable. The article Photogen is an illustration. It is a well written, practical article, which affords all the information on the subject which a reader can desire. We extract a part of it.

"PHOTOGEN. Syn. *Paraffine oil.* A term which has recently found its way into commerce, to designate certain oils or naphthas used for illuminating purposes. It is generally prepared from shales, brown coals, or cannels. Boghead coal and the numerous varieties of inflammable shales which more or less resemble it are specially adapted for the preparation of photogen. The chief physical difference between photogen and ordinary coal oils of the same boiling-point is the specific gravity, which with the former varies from 0·820 to 0·830, whereas common coal naphtha never has a less density than 0·850. It is true that photogen may be obtained of as high a density as 0·900, but then it will be of an excessively high boiling-point, and in all probability saturated with paraffine.

"The light oil known as photogen may be obtained from common bituminous coals, by distilling them at a lower temperature than is employed in gas works. To obtain the maximum amount of photogen from coal, the temperature should not be much above 700° C." For the details of the distillation of the coal we refer the reader to the work itself. The author continues: — "The tar obtained by any of the above processes is to be redistilled: the lighter portions form (when purified by sulphuric acid and alkalies) the fluid known in commerce as 'Boghead Naphtha.' In Germany and some other places it is usual to divide the distillate from the tar into two portions, one being for the preparation of photogen and the other for 'Solar Oil.' This division is made as the fluid runs from the still; the more volatile constituting the photogen, and the less the solar oil." The process of purification is then described, and some good practical hints are afterwards given to those who may engage in the manufacture. For instance: "In distilling the heavy oils or tars produced by distilling Boghead coal or other photogen-yielding substances, it is particularly to be observed that the worms or other tubes proceeding from the stills, if of too small diameter, are liable to become choked up with paraffine; this, if unobserved, might lead to serious results. It is very convenient to have a steam pipe inserted into the worm tubes or condensing tanks, to enable the water to be heated to such a point as to melt any solid matters in the worms, and allow them to be washed into the recipient by the fluids distilling over. . . . . It is curious to observe the effect of light upon photogen. Some samples of extremely dark colour, when exposed to its influence for a few days, become as completely bleached as animal oils would under these circumstances. At the same time, as we have before hinted, the odour becomes much improved. A photogen of good quality has by no means a repulsive odour; but if much of the more volatile constituents be present, it is impossible to avoid its being disagreable if spilled about. The less volatile hydrocarbons have comparatively little odour. It should not be too inflammable, that is to say it must not take fire on the approach of a light. If it does it is owing to the more volatile portion not having been sufficiently removed."

Among other articles which deserve to be specially commended, are those on "Peat and Turf," "Perfumery," and "Porcelain." On the whole we may say that this edition will maintain the character of its predecessors.

CORRESPONDENCE.

Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—Having waited some time to see if no one took up the opposite side of the above question, in reply to the proposition which appeared under the above heading in page 94 of your journal, I would merely suggest that T. S. Barrett seems in his arguments entirely to overlook the power which all particles possess of attracting or repelling each other.

He says,—"Because atoms are perfectly indivisible therefore they are perfectly hard." Agreed! "Because no fluid is perfectly inelastic, therefore no fluid can be perfectly hard." No! but its atoms may be perfectly hard.

It is now generally admitted by philosophers that the only difference between liquids and solids exists in the amount of repulsion between the particles, and not in any solidity or softness of the particles themselves.

By increasing the power of repulsion by means of heat there is no solid that may not be liquefied — not by any softening of the particles themselves, but by giving them more room to play around each other, and by lessening the attractive power which binds the particles together to form a solid.

It seems to me to be quite as illogical to say, that because a particle is solid a great number may not be liquid, as to say that because a thread of spun glass is as hard as the orginal glass, so must a cushion stuffed with a large quantity of the fibre.

Believing that T. S. Barrett has not looked at all sides of this much contested question before coming to a conclusion, I am, &c.

Ultimatum.

Glasgow, 1860.

The Pharmaceutical Society.

To the Editor of the Chemical News.

Sir,—In your last number of the Chemical News you have inserted Mr. Waugh's name as having received a certificate of merit in the Class of Chemistry and Pharmacy (of the Pharmaceutical Society), instead of my own; perhaps you will rectify the mistake next week. Mr. Waugh was not even a competitor in that class.—I am, &c.

F. Baden Benger.

338 Oxford Street.

Restoration of exhausted Manganese.

To the Editor of the Chemical News.

Sir, — I understand a process exists by which exhausted manganese can be restored to its original condition, and that such process is now in active operation; will any of your correspondents give the *modus operandi*?— I am, &c.

A Subscriber from the First.

Chemical Exchange Club.

To the Editor of the Chemical News.

Sir,—The communications I have received from yourself and others, induces me to offer a few more suggestions for the formation of the Chemical Exchange Club. The rules for the management of such a society need be very few and very simple. I would propose these:—

1. That the exchanges be made through the Editor of the Chemical News.

2. That gentlemen having specimens to exchange should forward them at their own charge to the office of the Chemical News, together with a list of the substances for which they wish to exchange them.

3. That lists of the articles received and the exchanges desired, be published at intervals in the Chemical News —say once a month.

4. That the specimens be sent in tubes of one uniform size.

I could wish myself that the system might be extended to minerals and geological specimens, but I am afraid that in such a case the trouble of distribution might be great. Specimens of minerals, however, might be reasonably included, and the usefulness of the club thereby very much increased.

I am, &c. F. C. S.

[We shall be glad to hear further on the same subject from our other correspondents. The suggestions for rules now published appear to us to include all that need be made.—Ed.]

Chemical Notices from Foreign Sources.

The Congress of Chemists at Carlsruhe.—We are enabled to give the following summary of the proceedings at the above congress through the kindness of a correspondent. The first meeting was held on Monday the 3rd of September, under the presidency of M. Weltzein. MM. Wurtz, Roscoe, Schischkoff, Strecker, and Kékulé were appointed secretaries, and after other elections and preparatory discussions the sitting closed, and the members fraternised together at a banquet laid for 120 persons in the large hall of the Museum. This supplementary meeting, which was not mentioned in the programme, was by no means the least scientific, the least relished, nor, above all, the least substantial, as we learn from the Abbé Moigno.

On Tuesday the 4th of September the work commenced. M. Boussingault, who was chosen at the first meeting to preside for the day, called forward the secretaries, who in the interval between the 2nd and 3rd of September had prepared the following questions, to be submitted to the assembly for discussion.

1st. Would it be judicious to establish a difference between the term *atom* and *molecule*?

2nd. Would it be judicious to designate by the term *molecule* the smallest quantity of a body capable of entering into combination?

3rd. Would it be judicious to designate by the word *atom* the smallest quantity of a body existing in combination?

4th. Should the term *compound atom* be suppressed, and replaced by the words *residue* or *radical*?

5th. Is the idea of equivalents empirical and independent of the idea of *atom* or *molecule*?

Professor Kékulé spoke upon the three first questions, and explained the motive which had induced the commission to frame them in this language. It was necessary to distinguish *atom* from *molecule*; furthermore, he insisted at length upon the distinction which ought to be established, at least in his opinion, between the *physical* and *chemical* molecule, which are not always identical. His opinion was that the size of the chemical molecule would always be of value in aiding purely chemical researches, and without the help of any physical considerations.

Professor Cannizzaro, of Genoa, in an impromptu speech, at once remarkable both for profundity and style, combated the ideas of M. Kékulé. In his opinion the chemical and physical molecules were absolutely identical, they could not be distinct one from the other. The gaseous molecule represented the chemical molecule, and it was impossible to conceive any other idea of a molecule. In the second place, the value of the chemical molecule could only be established in a certain manner, that is to say, by the *vapour-density*, which alone could serve to establish the true formula of a compound.

M. Secretary Wurtz resumed the discussion, and suggested that they should withhold any decision upon the distinction raised between the physical and the chemical molecule. He thought that upon the three first questions they would all agree, and passed on to the fourth proposition, expressed in these words:—Is it necessary to replace the word *compound atom* by one of the expressions *residue* or *radical*? Many chemists spoke upon this subject, particularly MM. Miller, Kékulé, Strecker, Persoz, Cannizzaro, and Béchamp. Their opinions were all more or less divergent. Other terms were proposed to replace the expression *compound atom*, but after a very long discussion the president suggested they should adjourn their decision, as the assembly seemed divided as to the resolution they should come to. A few minutes before the end of the meeting a loud applause announced the entrance of M. Dumas, of the *Institut*. The commissioner-general invited this illustrious foreigner to take a seat near the president's chair, and fresh applause bore witness to the value that the assembly attached to the presence of this eminent savant, whose works have contributed so largely to the progress of chemical philosophy. The secretaries then read the last proposition of

the commission:—Is the idea of equivalents empirical and independent of the idea of *atom* or *molecule*? No one thinking himself sufficiently strong on this point to give an opinion, the proposition was put to the vote, and adopted.

At the request of M. Boussingault, the chair was offered to Mr. Hermann Kopp for the next day's meeting. M. Kopp alleging the necessity which he was under to leave Carlsruhe that day, thanked the assembly, but declined the honour. M. Boussingault then proposed M. Dumas, who was ordained president by acclamation. The programme of the day being concluded, the meeting rose at three o'clock.

On Wednesday 5th September, M. Dumas in the chair. After the usual routine business the President invited MM. Miller, Anderson, and Will to take their seats near him. The Secretaries, in the name of the Commission, then read the following propositions inscribed in the day's programme.

1. Would it be desirable to place chemical notation in harmony with the progress of science?

2. Would it be judicious to adopt the principles of Berzelius, with the introduction of the necessary modifications?

3. Should any new signs be added to the number of symbols now in use?

M. Cannizzaro spoke first. The first question only required asking to be answered. They need not trouble much on that point. An ardent defender of the unitary system, he did not see it was necessary to preserve the notation of Berzelius, but would entirely adopt that of Gerhardt. A compromise which would modify the binary system, to introduce part of the unitary system seemed to him quite inadmissible; it would oblige chemists to retrograde. It seemed to him far preferable to start from Gerhardt's theory, and to discuss his plan and modify it in certain parts if necessary; moreover the reform introduced by the celebrated professor was not an abrupt leap, but was allied to all that preceded it. If Gerhardt had not introduced this reform another certainly would. The eloquent professor of Genoa then discussed the fundamental ideas of the unitary system; in his remarkable plea in favour of the theories of Gerhardt, he was obliged to show the impossibility, in the actual state of science, to adopt any other notation than that of the unitary school. He ended by asking all to admit at least in principle the new notation, and consequently employ the barred letters to represent the simple bodies corresponding to two volumes.

MM. Strecker, Kékulé, Will, Erdmann and Kopp spoke successively, some to corroborate the proofs given by M. Cannizzaro, and to strengthen the doctrine which he defended so valiantly, and others to combat it. All agreeing however to adopt the use of the barred letters.

The President resumed the discussion. He thought that the time had not yet arrived to adopt a definite method of notation; he wished to see at once added to the system of Berzelius the modifications which were rendered necessary by the recent progress of organic chemistry, whilst waiting for the final settlement of the question. One important point to which he called the attention of the congress was the necessity of looking at the requirements of instruction. In this respect unity in language and in theory seemed to be most desirable. He considered then that by the preservation of an entire freedom in the drawing up of scientific memoirs the professors should try to smooth as much as possible the difficulties produced by the divergence in these theoretical ideas. The President concluded by expressing the hope that this meeting would not be the last, and that next year the European chemists would again meet to discuss some of the points of a science cultivated at present with so much ardour and success. M. Dumas thanked in the name of the assembly the general commissioner for the zeal with which he had organised the congress, and begged M. Weltzein to express to H.R.H. the Grand Duke, who was absent from Carlsruhe, the thanks of the members of the congress. The session was then pronounced closed.

I. ORGANIC CHEMISTRY.

The Phosphorescent Matter of the Ray.—Dr. Phipson removed some of the luminous substance from a ray.[1] In the dark it seemed a sort of oil, which stuck to his fingers, and which shone under water as well as in the air. He put some of it into a bottle with a little distilled water. In about 24 hours the light went out, and the matter smelt something like rotten cheese, while the colour changed from grey-white to blackish-brown. The Doctor now examined the liquid for phosphorus, and could not find any; and he therefore has come to the same conclusion as many before him, namely, that the luminosity of fishes does not depend upon phosphorus. When placed under the microscope the matter looked like an amorphous mass, on which the Doctor remarked some small round bodies, which were evidently he says, the spores of fungi. He was at first inclined to think that the luminosity depended upon these, but now he believes that the phenomenon is due to some organic compound, not yet known, which has as great an affinity for oxygen as phosphorus. Here, however, is the difficulty which he sees: the phosphorescent matter of the fish shines under water, which extinguishes the light of phosphorus.

II. ANALYTICAL CHEMISTRY.

Estimation of Phosphorus in Iron and Iron Ores by Molybdate of Ammonia.—Eggertz states[2] that the precipitate produced by molybdate of ammonia has a constant composition when proper precautions are taken, and it is not dried at too high a temperature. At 95° it contains—

Molybdic acid	91·28
Phosphoric acid	3·74
Oxide of ammonium	3·31
Water	1·32
	99·65

The salt loses half its water when dried at 140°. It is completely amorphous, dissolves in 10,000 parts of pure water at 16°, and in 6600 parts of water containing 1 per cent. of nitric acid. It is much more soluble in alcohol, nitric and sulphuric acids, and ammonia.

The solution of molybdate of ammonia the author prepares in the following manner:—Sulphide of molybdenum, in fine powder, is roasted in a muffle at a low temperature; the residue is treated with ammonia; the liquid obtained is filtered, evaporated to dryness, and the residue lightly calcined. This residue is digested for several days with nitric acid at the temperature of the water bath. After this treatment the residue is dissolved in four parts of ammonia, and the solution is rapidly filtered and poured into 15 parts of nitric acid, sp. gr. 1·2. The liquor becomes yellow, and by degrees deposits some yellow phospho-molybdate; it then becomes colourless, and deposits no white precipitate when heated to 40°, but will if the heat be raised higher. It is this solution of molybdate of ammonia in nitric acid which is used for the estimation of phosphoric acid When the amount of phosphoric acid is very small, the quantity of molybdic solution used must be at least equal to half the volume of the liquor tested. Some organic bodies, such as tartaric acid, entirely prevent the formation of the phospho-molybdic precipitate.

To estimate phosphorus in cast iron or steel, Eggertz dissolves 1 grm. of the specimen, finely powdered, in nitric acid, sp. gr. 1·2, evaporates to dryness, moistens the residue with a little aqua regia, adds 4 cubic centimetres of water, filters, and washes until he has obtained 12 cub. cents. of liquor. To this he adds 12·5 cub. cents. of the molybdic solution, and then waits for 2 or 3 hours, occasionally shaking, and increasing the amount of the molybdic solution if no precipitate is obtained in the first hour. The precipitate is afterwards collected and washed on a tared filter, dried at 95°, and then weighed. The filtered liquor will still contain a little phosphoric acid, which may be estimated by a second process. Sometimes the solution of iron in nitric acid is difficult. In such a case the author says aqua regia may be used, but he thinks there may be a loss of phosphorus from the evolution of phosphuretted hydrogen.

[1] *Comptes-Rendus*, t. li. p. 541.
[2] *Journ. für prakt. Chim.* Bd. t. xxix. s. 490.

MISCELLANEOUS.

Museum of Practical Geology, Jermyn Street. The first of a series of ten lectures on the Chemical History of the non-metallic Elements, with reference to their application in the Arts, was delivered on Wednesday evening last by Dr. Hofmann, at the above institution. This course of evening lectures is intended for junior students and persons who being ignorant of chemistry, and prevented by other engagements from attending any course of instruction during the day, may yet be glad of the opportunity of obtaining an insight into the science, by spending an hour or two, one evening a week in listening to this eminent professor. The lecture on Wednesday last was in great measure introductory: the preparation and properties of hydrogen being the chief things treated of, but, in succeeding lectures will be described the physical and chemical properties of chlorine, and its analogues with their hydrogen compounds; common salt with the theory of salts in general—oxygen and analogous elements; illustrations and theory of combustion; water in its physical and chemical properties, composition and formation; sulphur and its applications; the atmosphere; ammonia; acids containing oxygen; chloride of lime; bleaching; chemical matches; nitric acid and applications; gunpowder; sulphuric acid, its manufacture and applications; phosphorus, silicium and boron, and their preparation; allotropic conditions of matter; rock crystal and glass; application of silica compounds to building; water glass; stereochromy; carbon in its different states of diamond, graphite, and charcoal, their applications and properties; use of carbon in producing light and heat; chokedamp; manufacture of aërated waters; hydrogen compounds of carbon; fire-damp in coal mines; the safety lamp; coal gas; nature of flame.

The above are only a few of the subjects which will be treated of in this interesting course. They will be copiously interspersed with experimental illustrations, which in Dr. Hofmann's hands are always ingenious and striking, and altogether will form one of the best and easiest means of obtaining an insight into the principles of chemistry. The lectures commence at 8 p. m. and as the fee for admission to the whole course is only 5*s.* we see no reason why all the schools within omnibus ride of London should not at once avail themselves of this privilege of acquiring the elements of chemical science under the instruction of the first chemist of the day.

A Medical Cooperative Establishment. — Why is it that we have no "General Metropolitan Dispensing Company," with branches in all parts of London, conducting dispensing business only, and that in such a manner and at such a price as would ensure success? Few of our already overworked general practitioners would continue to dispense their own drugs if they could have it done for them at a moderate rate. And supposing such a company to charge 3*d.* 6*d.* 9*d.* 1*s.* &c. for each prescription, the actual cost of the manufacture to exceed the next lower charge, I feel convinced not only that the generality of medical men would support the undertaking, but also, from the large amount of business that would be done, that the shareholders would reap a very handsome dividend. Stamps might be issued by the company, to be affixed to the prescription by the medical attendant, like our postage labels, such prescription to be made once only free of charge.—*Letter of a Physician in Lancet.*

The Smelting of Lake Superior Copper.— The following are the practical operations in the smelting of American copper:—

For the purpose of obtaining pure malleable copper from the masses, stamp and barrel-work sent down from the mines of Lake Superior, it is only necessary to separate the earthy matter which still adheres to the metal, and then to deprive the copper of the oxygen it has absorbed while in the liquid state. The furnaces are reverberatories of an ordinary construction.

Sometimes the whole process is conducted in a single furnace. In this case the ore is charged into the furnace, mixed with a flux adapted to the nature of the earthy matter under treatment. The heat is kept up till the whole is fused, when the copper, owing to its greater specific gravity, sinks, while the liquid earthy matter or slag floats upon its surface. This slag is now drawn off the face of the copper by means of rabbles, and the metallic bath is exposed. During the fusion the copper has of course absorbed oxygen, which, if allowed to remain would render the metal to a great extent, fragile. The surface is, therefore, covered with charcoal, and rods of green wood are plunged into the metallic bath, in order to reduce the oxide. The refining being completed, the metal is ladled out, and poured into moulds.

At other times, two furnaces are used, and in that case the metal is first obtained in the form of pigs, which are afterwards refined. The slags taken from these furnaces are very rich in copper, containing numerous shots and flakes of copper diffused through them. They are therefore worked over again with an additional quantity of flux, in order to obtain as much as possible of this retained metal. Still the slag is found to contain too much copper to be thrown away. In order to obtain this, the slags are passed through a small cupola furnace. The resulting slag may be considered clean, but there has been an unavoidable waste of copper, which has volatilised at the high heat of the cupola and passed out of the chimney.

The establishments at which the Lake Superior copper is worked are at Detroit, Cleveland, Pittsburgh and Boston.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

East Suffolk.—1. What is called milk of lime is made by slaking lime with a small quantity of water and then adding sufficient to make the mixture of a creamy consistence. 2. The boiler should be deep enough to hold three times the measure of the mixture boiled. 3. Tinned iron will answer.

R. D.—It is an optical phenomenon similar to the iridescence observed on mother of pearl scales. Aniline does not exist in coal, but is one product of its destructive distillation.

H. J. W.—The metal certainly is not rhodium. Try if it will not dissolve in nitrohydrochloric acid if it is finely powdered. The nitrate of potassa, or the water in which it was dissolved, must have previously contained lime, otherwise none could have been deposited on the basin.

L. G.—Thanks for the suggestion: the fraction was of course given in round numbers without pretending to strict accuracy.

Omicron.—Ordinary superphosphate of lime is formed by digesting bone ash in water to which is added a little more than two-thirds the weight in oil of vitriol of the bone ash taken. The liquid filtered from the gypsum which is produced contains free phosphoric acid and monophosphate of lime in variable proportions, and is freely soluble in water.

Book received—*A Lecture on the Cerebral Development of Infants*, by E. R. H. Unger, Ph.D.

Vol. II. of the Chemical News, containing a copious Index, will soon be ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our office, or, if accompanied by a cloth case, for 6*d.*

*** All *Editorial Communications* are to be addressed to Mr. Crookes, and *Advertisements* and *Business* communications to the Publishers, C. Mitchell & Co. at the Office, 12 Red Lion Court, Fleet Street, London. E.C.

CHEMICAL SOCIETY OF PARIS.

Répertoire de Chimie Pure et Appliquée, a Monthly Journal in Two Parts. The First Part, a record of the progress of Pure Chemistry in France and other countries, is published under the direction of Ad. Wurtz, with the assistance of MM. Friedel, Girard, Leblanc, and Riche in France; Williamson in England; Lieben in Germany; Kékulé in Belgium; L. Schischkoff in Russia; Rosing in Sweden and Norway; Frapolli and Arnandon in Italy; Muñoz de Luna and Lourenço in Spain. The Second Part, a record of the Applications of Chemistry is edited by Ch. Barreswil, assisted by D. Kœchlin, Hervé-Mangon, E. Kopp, De Clermont, Duvanne, and A. Vée in France; Sobrero in Italy; Roscoe and Smith in England; Knapp and Boettger in Germany; Rosing in Sweden and Norway; Boutlerow in Russia; Bleekrode in Holland; F. Storer in the United States. Each part is composed of two or three sheets in octavo. One part appears from the 1st to the 5th, and the other from the 15th to the 20th of each month. Agent for England, Baillière, 219 Regent Street, London.

THE CHEMICAL NEWS.

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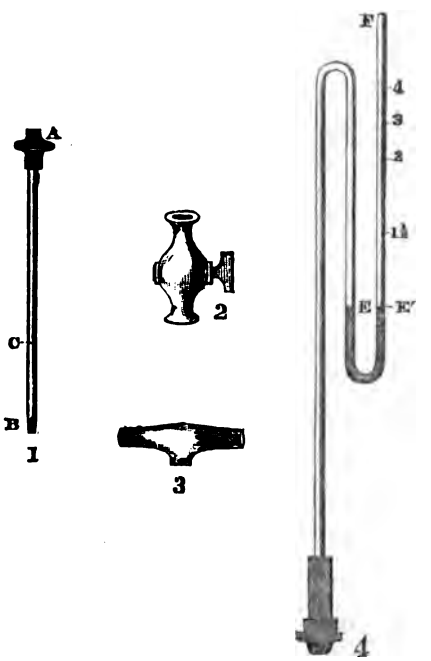
SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Determination of Carbonic Acid in Artificial Mineral Waters, by HARRY NAPIER DRAPER, *F.C.S.*

IN all works on quantitative analysis methods are given for the estimation of the carbonic acid which is held in solution by mineral waters, but I have never met with any modification of these operations which would render them applicable to cases where, as in artificial mineral waters, the gas is present in considerable quantity, and is held dissolved under pressure. In such cases, when the bottles containing the water are opened, all the contained gas, except that dissolved at the ordinary atmospheric pressure, escapes, and cannot be taken into account by any of the methods ordinarily in use. By the apparatus now to be described, the estimation of the entire quantity of gas is easily and simply effected, and it is applicable to all varieties of supercarbonated waters.



Description of the Figures. Fig. 1 is a tube of strong brass, furnished at A with a screw, and tipped at B with a sharp steel ferule. This tube is open at both ends, and is pierced at C with two small holes.

Fig. 2 is an accurately ground stopcock, which can be screwed on to A fig. 1.

Fig. 3 is a handle like that of a gimlet, screwing on to the other end of the stopcock.

Fig. 4 represents an air pump syphon gauge, of stout glass tube, securely cemented into a short brass tube, which is also provided with a screw, the thread of which coincides with those of the stopcock and the tube fig. 1. Mercury is poured into this tube and adjusted to the level E E'. The space E' F is then graduated, as shown in the figure, by first dividing it into two equal portions, and marking the point of division 2. The lower space is then subdivided in the same manner, and separating line marked 1½. The mark 4 is similarly obtained by dividing the upper space, and the 3 is placed at a point equidistant from 2 and 4.

Method of using the above Apparatus. I have devised two methods of accomplishing the purpose above indicated. The first of these is more suitable in cases where great accuracy is required; the second more practically applicable where an approximate knowledge of the gaseous contents of water is required, and where it is certain that these consist wholly of carbonic acid.

In the first case an ammoniacal solution of chloride of barium is prepared by mixing a saturated solution of the salt with half its volume of strong solution of ammonia, and allowing the mixture to become clear by subsidence. The determination is then proceeded with in the following manner. A glass flask, capable of holding half as much more fluid as is contained in the bottle experimented upon, is fitted with a cork, through which passes, nearly to the bottom of the flask, a glass tube. About two fluid ounces of strong solution of ammonia is now poured into the flask, and mixed with four ounces of distilled water. The stopcock being adjusted to the tube at A, the handle is now screwed on to the free extremity of the former, and by its aid the steel point is made to penetrate the cork of the bottle to be experimented upon until the orifices appear below its under surface. It is used, in fact, precisely as an ordinary cork borer. The handle is now removed, and the stopcock connected with the glass tube which passes into the flask, by means of a piece of vulcanised tubing about 6 inches long. The stopcock is next turned on just so much as will allow the gas to bubble slowly through the solution of ammonia. The whole is left in this position for twelve hours, by which time all the gas not held in solution at the ordinary pressure will have been absorbed. That which is still retained by the fluid may be either expelled by heating the bottle, placed in water, or the entire fluid may be mixed with the contents of the flask.

The carbonic acid can now of course be estimated by mixing the solution from the flask with about an ounce of the ammoniacal baryta solution above mentioned, gently heating, separating by filtration, and drying and igniting the precipitated carbonate of baryta as usual. If the whole of the aërated water have been transferred to the flask, and if it contain carbonates, or sulphates, or any earthy or metallic base, the weight of these must of course be deducted from that of the precipitate.

The second method of estimation cannot be considered as giving absolutely correct results, but from the facility with which it can be performed, it will be found useful where great accuracy is not required. It must be pre-

mised, however, that the necessary connection for temperature must be made, and when this was done I have found the results to coincide very closely with those obtained by the first described method.

In this case the stopcock, instead of being connected with the flask, is screwed into the mercury tube, fig. 4, and gradually turned until fully open. Now as water dissolves at the ordinary pressure of 30 inches, its own volume of carbonic acid, and as the quantity dissolved at other pressures is directly proportional to the pressure exerted, it is clear that if we know the amount of this pressure and the volume of the water in which the gas is dissolved we can, knowing also the weight of an equal volume of carbonic acid, determine by weight the quantity of the latter held in solution. Or, without knowing this latter number, we can express, as is most usual, the quantity of gas in cubic inches. Now it is also clear that as the volume of a gas is inversely as the pressure to which it is subjected, the mercury tube graduated as in the figure will show at a glance the number of atmospheres under which the carbonic acid is held dissolved.

Dublin, October, 1860.

Scale for the Conversion of Thermometric Degrees, by James Birney.

When it is required to convert degrees of the Centigrade thermometer into their equivalent degrees of the Fahrenheit scale, it is usual to make use of the following rule for that purpose:—multiply the degree to be converted by 9, divide the product by 5, and to the quotient add 32; and when Fahrenheit degrees have to be reduced to degrees of the Centigrade scale, it is done by reversing the process, viz. subtract 32, multiply by 5, and divide by 9.

With the aid of a scale like the accompanying the degrees of the above-named thermometers may be converted from one to the other with the greatest accuracy without making any calculations.

A simple inspection of the diagram will suffice to show the principle upon which the scale is constructed. Each degree Fahrenheit is divided into 9 parts, and each degree Centigrade into 5 parts, which are intended to represent fractions of a degree; the degrees themselves being numbered consecutively from the freezing point of each thermometer upwards.

A few examples will best explain the use of this scale. Suppose the temperature of a body to be 40° F. and it is required to know what degree that is on the Centigrade scale, by looking for the next degree Centigrade above 40° F. on the scale it is found to be 4 and 4 of the small divisions after it; 40° F. are therefore equivalent to 4°·4 C. or repeating the decimal figure for greater accuracy 4°·44 C.

When Centigrade degrees have to be reduced to degrees of Fahrenheit the decimal figures of the latter must be doubled to obtain the correct answer. For example, it is required to represent 3° C. by their Fahrenheit equivalent; referring to the scale we find the next degree Fahrenheit above 3° C. to be 37°·2, and doubling the decimal figure we have the correct answer 37°·4 F. Again, taking the outer columns of figures at the same place we find 13° C. corresponding to 55°·4 F.

On account of the zero point of the two thermometers being different, when converting degrees of the Centigrade thermometers into degrees of Fahrenheit the latter must be read from below upwards between the degrees of 32° and 0° Fahrenheit, that is contrary to the way above described.

Fahrenheit.			Centigrade.	
104	68	32 — 0	20	40
105	69	33		
106	70	34 — 1	21	41
107	71	35		
108	72	36 — 2	22	42
109	73	37		
110	74	38 — 3	23	43
111	75	39		
112	76	40 — 4	24	44
113	77	41		
114	78	42 — 5	25	45
115	79	43		
116	80	44 — 6	26	46
117	81	45		
118	82	46 — 7	27	47
119	83	47		
120	84	48 — 8	28	48
121	85	49		
122	86	50 — 9	29	49
123	87	51		
124	88	52 — 10	30	50
125	89	53		
126	90	54 — 11	31	51
127	91	55		
128	92	56 — 12	32	52
129	93	57		
130	94	58 — 13	33	53
131	95	59		
132	96	60 — 14	34	54
133	97	61		
134	98	62 — 15	35	55
135	99	63		
136	100	64 — 16	36	56
137	101	65		
138	102	66 — 17	37	57
139	103	67		
		68 — 18	38	58
		69		
		70 — 19	39	59

The scale may be extended for the *conversion* of *any* degree of either thermometer by extending the graduation lengthwise, or by continuing the figures at the sides forming new columns: and on the same principle scales may be constructed for converting the degrees of the thermometers of Fahrenheit, Celsius, and Reaumur the one into the other, and which might be advantageously substituted for the ordinary tables of conversion to be found in some scientific works.

Dublin.

On the Migrations of Phosphorus in Vegetables, by M. B. Corenwinder.

(*Continued from page 206.*)

Young Beans.—The analysis of the ashes of young beans, the two first leaves only being developed, give,

Phosphoric acid . . . 24·62 per cent.

In bean-stalks, where the seed has come to maturity, I could only detect very doubtful traces of phosphoric acid. It is remarkable that these results disagree as to the proportion of phosphoric acid contained in the ripe stalks with the figures shown by other observers. This difference is easily explained by observing that the exhaustion of the stalks ought to depend on the large or small quantity of seed produced, and the degree of maturity to which it has attained. It is clear that if the peas are gathered before they are ripe, the plant being provided with phosphates which are not used, we ought naturally to find a quantity in the stalks which has ceased to vegetate. If there is not any phosphoric acid in the stalks of beans which have vegetated under normal conditions, that is to say, when all the seeds have arrived at maturity, this is not the case when they are gathered prematurely.

As has already been observed, the tissue of fully developed plants only contains as mineral constituents, alkaline salts, nitrates, chlorides, iron in large quantity, and above all silica and lime. These two last substances are doubtless assimilated only by plants to give them the necessary rigidity; they are the agents which form the skeleton framework of the vegetable. The phosphoric element, on the contrary, does not remain in the tissues, it only runs through them; its destination is of a superior order. I have also remarked that the cotyledons exhausted by the development of the young organs give an ash formed principally of silica and lime, and destitute of phosphoric acid.

Long ago it was proved that the young buds of young vegetables were also rich in nitrogenous matter. This is always accompanied by a relative proportion of phosphorus, and it is not doubted that these two elements are united in the vegetable tissue, according to a method of combination still mysterious.[1] If a young vegetable is washed in cold water a certain proportion of alkaline or earthy phosphates are easily got from it.

If, on the contrary, a young plant rich in phosphoric acid and nitrogen is plunged quickly into boiling water, and the temperature is kept up till the water is reduced to a fourth of its original volume; by evaporating this separately and incinerating the residue it will be seen that the water has dissolved the alkaline and lime salts, but that the phosphates have almost entirely remained fixed in the plants.[2]

It is evident that by this rapid immersion the vegetable albumen is coagulated, which obstinately retains the phosphates which were first combined with it. If, on the contrary, we let it lie in cold water, the albuminous matter being soluble in water draws out these salts.

One cannot but admire this foresight in nature which has fixed in the young plants generally destined for food, by the side of the molecule of nitrogen which produces the muscular flesh, the molecule of phosphorus which consolidates the bones. On the contrary, those parts of vegetables improper for animal assimilation are deprived of phosphoric acid; the ashes of the woody shell of walnuts, almonds, filberts, &c. are so to speak, composed of silica and lime, and, as I have already shown, all plants fully developed are the same.

M. Boussingault has long felt convinced that the truffle, the beetroot, and the turnip contain far less nitrogen after producing the seed, and everyone has noticed that in this state forage is very deficient in nutriment for cattle. It is then quite legitimate to establish henceforth an incontestable connection between phosphorus and nitrogen in organic life, and I believe that it is not hazardous to admit, as I said before, that these two bodies, or rather their compounds, are united in the living tissues, according to a particular mode of combination.

(*To be continued.*)

[1] It is known that some time ago M. Boussingault made this important observation, that all substances rich in nitrogen are also rich in the phosphoric element.

[2] This may explain a fact which has long been known to careful housewives:—that the water in which vegetables are to be cooked should always be made to boil before they are immersed.—Ed.

TECHNICAL CHEMISTRY.

On Béchamp's Process for Preparing Aniline, by C. Greville Williams.

The importance of aniline as a source of colouring matters is so great, that it is desirable to clear up any apparently obscure phenomena presenting themselves during its preparation by any of the processes commonly employed.

Those who have made aniline by Béchamp's process, have probably observed on rectifying the crude base, that the first small portion distilling over floats on, instead of sinking in the accompanying water. Now the specific gravity of aniline being 1·02, it is plain that the levity of the base is due to some accompanying impurity. A small portion of this fluid, lighter than water, was placed in my hands for examination. It appears that manufacturers of aniline carefully remove the impurity, for none of the samples of aniline I have met with in commerce, contain any of the light substance.

After careful drying by digestion with sticks of potash. it was submitted to fractional distillation. It commenced to boil at 220° F. This indicated the presence of some substance having a boiling-point far below that of aniline. The first portion of the distillate was heated with excess of hydrochloric acid, when a minute trace of benzole remained insoluble. The amount being far too small to have caused the depression of boiling-point, the solution was passed through a wet filter, and then supersaturated with solid potash. A fluid rose to the surface, it was removed and dried in the usual way. On rectification it distilled chiefly between 150° and 194° F. A little aniline remained in the retort. The first portion of the distillate was repeatedly rectified, the less volatile portions being rejected.

As now prepared the substance presented itself under the form of a transparent colourless fluid of peculiar odour, resembling that of certain volatile bases. It fumed on approach of a rod dipped in hydrochloric acid.

It entirely dissolved in the last named acid, at the same time becoming warm. Bichloride of platinum added to the solution, gave after a time a small orange-coloured granular precipitate, appearing under the microscope in the form of minute octahedra. The hydrochloric solution on evaporation in the water-bath gave a very small cystalline residue.

On analysis, the portion distilling between 150° and 164° F. gave the annexed numbers:—

I. 0·2134 gramme of liquid gave
0·4832 „ „ carbonic acid, and
0·2064 „ „ water.
II. 0·2100 „ „ liquid gave
0·4762 „ „ carbonic acid, and
0·2020 „ „ water.

A nitrogen determination by Dumas' method, gave so small a proportion that it was evident any nitrogen present was a mere impurity. The above numbers calculated in the hundred parts, give:—

	I.	II.
Carbon	61·8	61·8
Hydrogen	10·8	10·7

Agreeing with the formula

$$C_6H_6O_2.$$

The fluid appears, therefore, to be almost pure acetone, as will be seen by the annexed comparison of the numbers obtained by experiment with those required by theory.

	Experiment.			Calculation.		
	I.	II.	Mean.			
Carbon	61·8	61·8	61·8	C_6	36	62·07
Hydrogen	10·8	10·7	10·8	H_6	6	10·34
Oxygen	27·4	27·5	27·4	O_2	16	27·59
	100·0	100·0	100·0		58	100·0

The vapour-density was, by experiment, 2·09, agreeing sufficiently with the theoretical number 2·00 for four volumes.

The fluid alluded to contained traces of aniline and ammonia in solution, the presence of the latter being the cause of the hydrogen coming out somewhat high. The fact of its being acetone was corroborated by its behaviour with solid potash. The latter became first yellow and then brown, in the same manner as occurs with that substance. Sodium caused the production of a thick fluid having the characteristic odour obtained with acetone under the same circumstances.

The quantity of the light liquid formed during the preparation of aniline by Béchamp's process, is, in carefully conducted operations, exceedingly minute; it is said, however, to be invariably present. It would appear to be produced by the decomposition of a little of the ferrous acetate used.

On the Manufacture of Murexide on the Large Scale, by M. Braun.

(*Concluded from page* 209.)

Extraction of the Uric Acid contained in Guano.—The treatment of guano by hydrochloric acid, recommended by Mr. Brooman, is a valuable means of extracting the uric acid, because it preserves not only all the useful matter contained in the guano, but still more because it greatly facilitates the extraction of the acid. Having thus treated the guano by hydrochloric acid, Mr. Brooman extracts the uric acid by a prolonged washing in caustic soda at boiling heat; he then precipitates a large portion of extractive matters by caustic lime; after having clarified the solution, the uric acid is precipitated by means of hydrochloric acid. The following are the details of his process:—

Pour 340 litres of water into a copper boiler holding 453 litres, and 4·480 kilos. of caustic soda, and the mass obtained by the treatment of 1·12 kilos. of guano submitted to the action of hydrochloric acid, then washed with water. Heat the mixture to the boiling-point, taking care to shake it well, and maintain it at this temperature for an hour. Add a milk formed of from 1·120 kilos. to 1·680 kilos. of caustic lime. Shake it well, and boil it again for a quarter of an hour, take it from the fire, and let the liquid remain in the boiler to clarify. This requires only three or four hours, after which it can be decanted by means of a syphon into a deep reservoir. While the liquor is still hot separate the uric acid by adding hydrochloric acid a little in excess. The uric acid precipitated thus while hot has a greater consistence, is speedily deposited, and is more easily washed and collected on the filter. After this last operation it must be dried on a stove. It must be observed that the lime should not be added until after the reaction produced by the caustic soda, whilst up to the present time the two alkalies have been employed simultaneously.[1] In this case there is always formed urate of lime, for the solution of which a great quantity of water is required; in manufacturing on a large scale this would necessitate the operating on a very considerable mass. By the new method, on the contrary, only urate of soda, readily soluble, is obtained; the caustic lime, combined with a quantity of extractive matter, merely assisting in the clarification. On this account, and to avoid the formation of earthy urate, the author employs lime only in proportion to the excess of caustic soda. When all the clear liquid is removed from the boiler, a quantity of water, equal to that at first employed, is poured on the residue, and from 2·800 kilos. to 3·360 kilos. of caustic soda are added; the process is then continued as before described, unless only from 0·560 to 1·120 kilos. of lime, reduced to a state of hydrate, have been used to clarify it. After this second reaction the uric acid is generally completely extracted from the guano, but although it is of very good quality, yet it must be submitted to a third operation, in which still less caustic soda and lime are consumed. The residue in the boiler, after being dried, furnishes very good manure. The uric acid procured in this way can be immediately employed in the manufacture of murexide without undergoing any other treatment; nevertheless, it is yellow in colour, which proves that it is not chemically pure. But although it contains from 3 to 5 per cent. of extractive matter, it is perfectly fit for the manufacture of the murexide used for dyeing, because during the subsequent oxidation by nitric acid, the foreign matter is diminished, and the washings carry away the remainder.

Manufacture of Murexide after the Extraction of the Uric Acid.—It is stated in works on chemistry, that nitric acid transforms uric acid first into alloxan. In the first place, it is necessary to establish

[1] Especially in the process described by Dr. Bensch in the *Annalen der Chemie und Pharmacie*, 1846, vol. lviii. p. 266. This chemist says that the guano should be boiled for several hours with potassa, hydrate of lime, and a sufficient quantity of water, then filtered through a strainer and evaporated until it is reduced to a thick magma, which should be pressed between linen cloths. The residue is diluted with water and treated with hydrochloric acid. The rough uric acid thus obtained should be washed in water, dissolved in dilute potassa, and evaporated until it is reduced as formerly to a pulpy mass, and again strongly pressed between linen cloths. Thus is obtained urate of potassa, which must be well agitated in a double quantity of water, and submitted quickly to pressure. These successive operations are repeated three or four times, or until on trial with hydrochloric acid the uric acid is produced perfectly white. Then the well purified urate of potassa is dissolved in hot water charged with potassa, and the clear solution is poured into an excess of hydrochloric acid. By this process Dr. Bensch obtained only 1·260 kilos. of pure uric acid from 56 kilos. of guano.

the proper relation between the two acids. After numerous experiments the author has discovered that 0·980 kilos. of uric acid should be used to 1·187 kilos. of nitric acid, of a strength of 36° Baumé, and the operation conducted as follows:—

Put the nitric acid into a deep earthen vessel, and float it and its contents in a larger vessel full of water, having made arrangements for renewing the water as it gets hot. The uric acid is then added little by little to the nitric acid; each portion not exceeding 35 grammes, so as not to elevate the temperature to such a degree as would cause the alloxan which is formed to decompose into various products not yielding murexide, and thus occasioning loss. The uric acid should be added by scattering it over the surface of the nitric acid; stirring the mixture with a porcelain spatula should not be commenced until the uric acid is in great measure decomposed. In operating thus the developed heat dissipates itself more quickly. More uric acid should not be added until the temperature has diminished to 32° C. at least. In proportion as it proceeds the reaction becomes less lively, when the mixture must be shaken, and the uric acid mixed with the nitric acid before the liquid cools to the point when oxidation ceases; when this is the case the mixture must be reheated a little. But the necessity for this happens only in winter.

At the temperature of 32° C. which must be carefully maintained, the last portions of uric acid are not decomposed; moreover the relation between the two acids is fixed with a view to obtaining this result.

It is not advisable to act at once upon quantities of nitric and uric acid, larger than those which have been prescribed; but in operating on a large scale a certain number of capsules should be disposed in the same refrigerator, care being taken to provide for the expulsion of the vapours which arise.

After cooling a mass of crystallised alloxan mixed with uric acid, water and a little free nitric acid are found in the capsule; the yellow colour of the liquid arises from the decomposition of the extractive matters retained in the uric acid. The product of two operations, 1·960 kilos. uric acid, and 2·380 kilos. nitric acid, are then combined, put into an enamelled cast-iron boiler holding 17 litres, and the boiler is placed on a sand-bath. By the effect of heat the dilute nitric acid recommences acting on the uric acid remaining in the mixture, and forms a further quantity of alloxan. The liquid is then seen to swell. It ought to be removed from the fire as soon as it reaches half the height of the sides of the boiler. Care must be taken not to shake it, and when it subsides replace it on the fire, and remove it again a little time after. When it is heated for the third time there is no longer fear of its boiling over, and the temperature is then raised to 110° C. and the vessel is transferred to a less heated part of the sand-bath, and into the mixture is poured, shaking it meanwhile as rapidly as possible, 200 grammes of liquid ammonia at 24° Baumé, which completely transforms the mixture into murexide. After the introduction of the ammonia the boiler is left for two minutes in the sand-bath, when it is taken off and left to cool, and a soft paste of a deep reddish-brown colour is found in it. This paste is composed principally of murexide mixed with nitrate of ammonia, brown extractive matters, &c. This is what is called in commerce murexide in paste. To obtain dryer and purer murexide this cake is mixed with water, washed and filtered with care so as to get rid of the salts. The last washing should be with dilute ammonia. The product then dried on a stove constitutes the dry murexide of commerce.

PHARMACY, TOXICOLOGY, &c.

Balsam of Peru.

The balsam imported into England as balsam of Peru, is produced within the department of Sonsonate, in the republic of Salvador, and along the coast of which department the trees from which it is extracted extend for leagues.

In the district of Cuisnagua there are 3574 trees, which yield altogether only 600lbs. of the gum annually. With proper care in the extraction each tree would yield from two to three pounds, making the total quantity capable of being produced, in the before-mentioned district, about 10,000lbs. When the season has been more rainy than usual the product is much lower; but in order to meet this difficulty, the Indians heat the body of the tree by fire,—by this means causing the gum to exude more freely; this operation invariably causes the decay of the tree.

Should this mode of extracting the gum by heat not be put a stop to, the tree will soon disappear from the coast. This fact has been brought to the notice of the Government, and inquiries into the matter have been made in consequence.

The Indians employed in collecting the gum say that such trees as are well shaded yield a greater quantity, but that those which have been planted by hand yield the most. This has been proved by experience, particularly in Calcutta, where a considerable quantity is yearly collected from trees which have been so planted. During the months of December and January, the gum oozes away spontaneously. This class of gum is called "Calcauzate." It is orange-coloured, weighs less than the other, emits a strong odour, and is volatile and pungent.

The export of balsam from Salvador in 1855 was 22,804lbs. valued at 19,827 dollars. On the coast of Chiquimulilla, in Guatemala, there are many trees of the description that yield the balsam; but hitherto it has not attracted the attention of the people of the country to collect it and bring it to market. That part of the coast in the State of Salvador, extending from Acajutla to Libertad, is emphatically termed the "Balsam Coast," because there only is collected the article known in commerce as the balsam of Peru.

The particular district is intermediate to the two ports, and does not reach either of them within three or four leagues. Lying to the seaward of a low lateral ridge of mountains, the whole tract, excepting a few parts on the borders of the ocean, is so much broken up by spurs and branches thrown off from the main eminence, and so thickly covered by forest as to be nearly impassable to a traveller on horseback. From this cause it is so rarely visited that very few residents either of Sonsonate or Salvador, have ever entered it. Within this space are situated some five or six villages, inhabited solely by Indians, who hold no intercourse with other towns than what is necessary for carrying on their peculiar traffic. Their chief wealth is the balsam, of which they take to market from 18,000 to 23,000lbs. weight annually. It is sold in small portions at a time, in the before-mentioned towns, to persons who purchase for exportation. The trees yielding this commodity are very numerous on this privileged spot, and apparently limited to it: for in other parts of the coast, seemingly identical in soil and climate, rarely an individual of the species is met with. The balsam is extracted by making an incision in the tree, whence it gradually exudes, and is

absorbed by pieces of cotton rags inserted for the purpose. These, when thoroughly saturated, are replaced by others, which, as they are removed, are thrown into boiling water. The heat detaches it from the cotton, and the valuable balsam being of less gravity than the water, floats on the top, is skimmed off, and put in calabashes for sale. The wood of the tree is of a close grain, handsomely veined, nearly of a mahogony colour, but redder; it retains for a long time an agreeable fragrant odour, and takes a fine polish. It would be excellent for cabinet-makers, but is seldom to be obtained, as the trees are never felled, until by age or accidental decay all their precious sap is exhausted. This balsam was long erroneously supposed to be a production of South America; for in the early periods of the Spanish dominion, and by the commercial regulations then existing relative to the fruits of this coast, it was usually sent by the merchants here to Callao, and being thence transmitted to Spain, it there received the name of the balsam of Peru, being deemed indigenous to that region. The real place of its origin was known only to a few mercantile men.—*Technologist.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A. F.R.S.*

Lecture VII. *The Action of Water in its Circulation through the Earth.*

(*Concluded from page* 225.)

And now is forced upon us a view of nature and of the operations of nature in the interior of the earth, which is almost oppressive from the extreme difficulty the human mind has in grasping a conception so opposed, it may seem, to the evidence of the senses.

We speak of the grave as silent—we think of the ground and the rock as permanent, and almost as if they were eternal. We cannot feel that all beneath our feet is changing, and that there is a kind of life even in dead matter. We cannot see it, but a circulation really goes on in all material substances, and it is consistent with apparent and external repose; for if we examine and carefully describe an object or a state of matter at one time, and afterwards—after a sufficient interval, repeat our investigation, we may find perhaps the same form but a different substance: there may be the same appearance, but there is a new and changed texture.

Nature indeed knows no repose. The minute atoms of which solids are formed. however compactly placed they may seem, are removed from each other by a distance which is large in proportion to their size — large enough at any rate to admit of any amount of motion amongst themselves, large enough to let atoms of other matter circulate amongst and replace them; large enough to allow the combined atoms of hydrogen and oxygen as water to penetrate them.

The mud deposited to-day at the mouth of the Rhine, the Ganges, or the Mississippi is a mechanical mixture of lime and clay and water with grains of sand, fragments of wood and bone, marine and fresh water shells, particles of iron oxide, and the infinity of miscellanea that cannot fail to be brought together by fresh water running over a surface of land which is covered with vegetation and with animal life, and ultimately terminating its course and depositing its load where it meets the tidal wave of salt water.

This mud deposited to-day will be buried to-morrow, and in the course of centuries will be covered up thickly, and remain permanently buried for a long time.

What then will happen? Do you suppose all will remain quiet? Do you suppose that having entered nature's great laboratory these materials will be left idle? Banish such a notion from your minds, and listen to what really will take place.

First decomposition commences, or advances if it had already commenced, in the organic matter. Gases will be evolved, these will affect the other compounds otherwise permanent; elective affinities will be called into play, and a general re-arrangement take place of all the particles until they attain a first state of temporary equilibrium. During all this time they are saturated with water, a heavy column of water presses upon them, and their temperature is more or less equable in proportion to the depth of the deposit.

By degrees the water gets to a certain extent squeezed out of them, and they become solid instead of pulpy. The attraction of cohesion acts, and at last the wet pulpy mud either becomes changed into tough clay, or a sort of half-formed limestone is formed, or the mass remains loose sand.

Then come into play those movements of the earth's surface which in other lectures I have described as so common. The ground sinks, the deposit continues, and at length the former mud becomes exposed at a steady even temperature of some 200° or 300°, under great pressure of earth and water, to those magnetic currents which circulate through the earth. Then begins a fresh series of changes, crystallisation starting at some atom of foreign matter. Some mud passes into tough clay, the lime-mud passes into beds of limestone, impurities and foreign substances accumulate together in bands, the shells become crystalline, and all are cemented together; undecomposed wood tends to become coal, silica takes the place of some of the organic matter; the sulphur and phosphorus set free from animal matter enter into new combinations; the mass in drying contracts irregularly, and is full of cracks and fissures, and in these water circulates, being forced through at a temperature corresponding to the depth. As it circulates it carries with it from place to place various minerals; removing them from one point and leaving them behind at others according to the nature of the chemical operations going on.

After a time the beds sink lower, the clays become subject to greater pressure, the limestones get compact and pass into marble; the metals combined with oxygen or sulphur group themselves together in cavities with other minerals earthy and crystalline.

One step more — elevation begins. The clays are now subjected to the pressure from below as well as above, and under this double squeeze they become twisted and bent like pieces of cloth, and they also assume a new lamination. They become slates. Some of the sandstones have become by this time converted into quartzite and the limestone has completed its crystallisation. When elevation comes these hard beds being brittle are broken, leaving large open spaces and great cavities beneath the surface. Here also water collects.

Yet again. Far down, at a depth of tens of thousands of yards, and therefore under great pressure, water in company with the minerals which form granite accumulates in a mixed mass, and a slow but incessant crystallisation goes on amongst them, in which the water is entangled with the other minerals, and helps to form a part of the substance of each crystal. We may even imitate this effect on a small scale by bringing similar causes to bear.

But in all this there is no melting such as we have in volcanic rocks. In these latter water is not present in the same way; they were formed much nearer the surface; and they belong to a different class of phenomena. Their origin is detected by the absence of water in them.

Wherever great change has taken place at great depth—wherever is seen the rich variety of minerals and the valuable supply of metals,—there water has acted.

Water carried down in the rocks that descend is worked up into new forms, and is only returned to the surface when it has done its work and when other supplies from above have replaced it.

And in time the rocks thus elaborated rise again — some

at small depth will have been little altered, and with their original water will form gravel, and surface clay, and sand or soft limestone: — some, deeper and more altered, will show the effect of chemical action by unmistakeable chemical and atomic change, while the wealth of fossil organic remains still present, sufficiently speaks of their mechanical origin: others again much deeper will have been so completely altered as to have lost all trace of this life origin. It does not the less follow that they have once contained fossils as distinct and as numerous as in any recent deposit.

As each rock comes again within the influence of surface disturbance, it will be again worn away by the river, or beaten into fragments by the tidal wave; water will once more destroy what water originally formed, what water afterwards modified, and what will once more be converted into a deposit at the bottom of the ocean, the grand reservoir of the same ever present, ever active element.

In all the great circle of changes concerning which geology informs us water is then the chief agent. Heat and chemical action of themselves can do little, and certainly could not produce what is needed for our world. They act with and by water, and thus produce their results.

Abstract this important form of matter and consider what the result would be. The great ocean would be but a salt desert without an oasis, the land a dry parched rock; there would be no life, animal or vegetable, not even the smallest animalcule or the red lichen on the snow. The sky would be without cloud, and the thermic and magnetic currents would cease to vivify the dry bones that would then form but a skeleton of the earth.

Water is the life of the earth as blood is the life of man. This is a wonderful and instructive analogy, and one which may lead to many useful suggestions in the contemplation of nature.

ROYAL INSTITUTION OF GREAT BRITAIN.

The Duke of Wellington, *K.G. D.C.L. Vice-President, in the Chair.*

On the Electric Silk Loom, by Professor Faraday, *D.C.L. F.R.S.*

"Illustrans Commoda Vitæ,"[1] the motto of the Royal Institution, was made the ruling principle on this the last evening of the season; an account being given of the application by M. Bonelli of electricity to the service of the figure weaving-loom. The astonishing condition of perfection to which M. Jacquard had brought the silk loom, so that artists of the highest rank could not, without minute inspection, distinguish its results from the most perfect engraving, and the manner in which he taught the weaver to construct a series of cards, and then to use them automatically, so as to produce as often as he pleased the design which they represented, are well known. Any effect of pattern, either simple or complicated, which is produced in the woven fabric depends upon the manner in which the threads of the warp are separated before the weft is thrown, and the successive re-arrangements of the warp threads which are brought about each time the shuttle is passed; a single thread of the weft therefore represents an element of the design; and in the Jacquard loom each of these required a card pierced in a certain order, which, being brought against the ends of a set of horizontal rods, allowed some to remain undisturbed, whilst others were pushed on one side. By the action of the pedal the warp threads associated with the undisturbed rods were raised, and those belonging to the displaced rods were left unmoved; and to do this rightly, a separate pierced card was required for every thread that crossed the warp within the extent of the pattern. Frequently some thousands of cards are needed, and for the production of a woven portrait of M. Jacquard, in black and white silk, as many as 24,000 were employed.

[1] Lucretius, iii. 2.

After a design has been decided upon, it has to be converted into these cards, one for each thread of the weft included in the design; the preparation and piercing of them requires much care and time, after which they have to be linked together as an endless chain in their proper order. It is to replace this part of the weaving arrangements that M. Bonelli has applied his attention, and the peculiar power of electricity. Instead of the many pierced cards, he has but one card, or rather its equivalent, a convertible plate of brass; which, being pierced with the full number of holes required (which in the loom in action was 400), can have these holes either stopped or left open, so as to represent by its successive changes of condition the successive cards of the Jacquard series. To obtain this effect, tin-foil is attached strongly to paper, so as to form a compound sheet. The design is then drawn upon the metallic surface with black bituminous varnish, and the sheet is made into an endless band, which being placed upon a roller, and kept in its position by stops, moves as the roller moves, being carried forward by its motion. A set of teeth rests upon the top of this roller, touching the pattern in a line; they are made of thin brass plate, so thin that 400 of them do not occupy more than 16 or 17 inches, *i. e.* the width of the design on the roller; yet so separate that each is insulated from its neighbour by little interposed teeth of ivory; and so large and therefore weighty as to fall and rest upon the pattern, making good electrical contact where the tin-foil is exposed, but being insulated where the bituminous pattern intervenes.

Behind these teeth are 400 small electro-magnets fixed in a framework, parallel to each other, and insulated. The fine covered wires which constitute their helices are connected at one set of ends with the teeth just described, each with a tooth; whilst the other ends are brought together and made fast to one metallic plate and wire. Tracing this wire onwards, it comes to an interruptor or contact-maker from whence the metallic communication proceeds to a screw appointed to communicate with one end of a five-celled Bunsen battery, the other end of which communicates with a screw near the former. This screw has a wire proceeding from it to two insulated teeth, like the teeth bearing upon the pattern, but heavier; and these rest upon the uncovered edges of the tin-foil at the sides of the pattern, so as to keep up a constant electric communication with it. By simple, but perfect and secure mechanical arrangements, the following movements and results take place in this part of the apparatus. As the pedal descends under the weaver's foot at a certain time, the 400 teeth descend upon the pattern; then the circuit is completed at the interruptor in the single wire; the electric current passing through that wire, is divided into as many portions as there are teeth touching the metal in the line of pattern under realisation; it makes all the electro-magnets surrounded by these wires active, leaving the others non-magnetic; and then, as the foot is raised and the movements return in their course, the interruptor is first separated, which causing all current to cease, the magnets lose their power, the teeth are raised from the pattern; and then the cylinder carrying it moves forward just so much as to give the new line of pattern for the teeth to search out electrically (the next time they descend), which corresponds to the next cast of the weft thread. Because the pattern never moves whilst it is in contact with the teeth, it is not cut or worn by them; because the current is made by the interruptor after the teeth are in contact, and before they are separated, no fusion or burning of the metal occurs at the teeth; and because there is a tongue-like wiper or brush, which, at the right time, passes under the teeth, sustains them and from off which they rub on to the pattern, there is never any want of cleanliness or of contact there.

Associated with these 400 magnets, and in the same line with them, are 400 cylinders of soft iron, called pistons; they are carried in a frame which moves to and fro horizontally between the magnets and the horizontal rods belonging to the suspensions of the warp threads; and they move towards the magnets at a time so adjusted as to coincide with the

passage of the electricity round its circuit: they find therefore some of the magnets excited, because their teeth touch the metal of the pattern; and as the box of pistons begins to return before the current is interrupted, such of the pistons as have touched excited magnets are retained or held back, whilst the others have returned in their course; the pistons therefore are divided into two intermixed groups of which the one group is perhaps half an inch behind the other. Now comes in the action of the perforated brass plate, which is to be converted for the time into the equivalent of the particular Jacquard card required. It is a vertical plate associated with the extremities of the pistons farthest from the electro-magnets: it can move up and down to a small extent: it is pierced by 400 circular holes. The 400 pistons have each a head or button, which can pass freely each through its correspondent hole when the plate is up, but is stopped at the hole when the plate is down, and then effectually closes it. Now the time is so adjusted that when the box of pistons has moved so far forward as to cause separation of the two groups, the plate descends, and by locking such of the heads as belong to the unretained group, fills the corrrespondent holes, whilst the heads of the retained group, being already behind their holes, have left them open; and so the Jacquard plate is formed, and, moving a little further, it acts on the horizontal rods before mentioned, and having by that arranged the suspenders of the warp threads, it then goes back, or towards the electro-magnets, to take up, under the iufluence of the currents of electricity through the selecting teeth, the new arrangement of apertures required for the next cast of the weft thread.

The use of electricity, for the purpose of reading off the design and conveying it into the loom, involved many peculiarities, conditions, and difficulties. These were considered; and the manner in which they were either turned to advantage or overcome was illustrated by large and separate experiments.

MANCHESTER GEOLOGICAL SOCIETY.

At the last monthly meeting of this society, T. A. Readwin, Esq. F.G.S. read a paper *On the Gold Discoveries in Merionethshire, North Wales*, and exhibited numerous remarkably rich specimens of gold ore, which the members examined with great interest. I shall confine my remarks (said Mr. Readwin) in this paper to an area of about twenty square miles, situate north of the river Mawddach, between Dolgelly and Barmouth, county Merioneth; which, for the purpose, may be called Dolgelly district. This district may be said to be bounded by the river Mawddach, the great Lawllech or Merioneth anticlinal range, and the river Camlan; to which may be added a continuation of three or four miles further north-east, following the junction of the Cambrian Sandstones and the Lower Silurian Lingula flags of the Geological Survey, and included in the survey maps 75 N.E. and S.E. My friend Professor Ramsay, in a communication to the Geological Society of London, in February 1854, on the *Geology of the Gold-bearing districts of Merioneth*, has so elaborately described in detail the geological conditions of this peculiar district, that it is unnecessary to do more than refer to his paper. I must, however, briefly state that the Cambrian Sandstones are overlaid by the Lower Silurian Lingula flags. The Cambrian rocks are coarse greenish-grey grits. The Lingula flags are chiefly slaty beds, more or less arenaceous, and interstratified with courses of sandstone. Both the Cambrians and Silurians are frequently penetrated by light grey calcareous and ordinary greenstone dykes, some of which are magnetic. In the Cambrian sandstones these dykes appear to run in all directions, the general direction being rather across the strike. In the Silurian region, the direction of the dykes is generally parallel with the lines of bedding. Palæontologically, the district may be said to be barren. No fossils have yet been found in the Cambrians of Merionethshire.

The principal mines where gold has been found in this district are as follow:—

At Cwm eisen uchaf—in galena, mundic, copper pyrites, quartz, blende, schist, and arsenical pyrites.

Cwn eisen Issa—in galena, and I believe in blende.

Dol-y-frwynog—in galena, quartz, baryte, and mundic.

North Dolfrwynog—extracted from quartz, copper pyrites, and gossan.

West Dol-y-frwynog—in quartz, schist, and baryta.

Tyddyngwladis—in argentiferous galena, copper pyrites, clay-slate, talcose schist, gossan, and blende.

Caergwernog—in argentiferous galena.

Berthllwydd—in argentiferous galena.

Prince of Wales Mine—in blende, galena, quartz, and clay-slate.

West Prince of Wales Mine—in blende, carbonate of lime, schist, quartz, clay-slate, iron pyrites; chiefly in blende and quartz.

Victoria Mine—extracted from quartz and gossan.

Lachfraith—extracted from quartz and pyrites.

Caegwain—extracted from quartz and galena.

Vigra—extracted from gossan, quartz, and copper pyrites.

Clogau South Grant—extracted from gossan, blende quartz, and copper pyrites.

Clogau Middle Grant—traces of gold in copper pyrites.

Clogau North Grant from St. David's lode—in quartz, copper pyrites, carbonate of lime, talcose schist, and galena.

Gold is said to have been found at Penmaen, and at Gelligain, about three miles south-south-east of Trawsfynydd. There are many mineralised quartzose veins in the Clogau mines; but in that called the "North Grant" is the most remarkable, called the "St. David's," or the "Gold Lode." This lode has a direction nearly east and west, and is almost perpendicular. It is from 2 ft. to 3 ft. wide, and impregnated with sulphides of copper, lead, iron, and zinc, and also with native gold. I shall not do more in this notice than refer to the Clogau mines, which are partly in the Lingulas and partly in the Cambrians. In the northern portion of these mines there is a junction of these rocks having a dip to the south. It is worthy of notice that this lode is at the junction of the Cambrian sandstones and the Lingula flags; for, according to Sir R. Murchison, "the most usual position of gold is in veinstones that traverse altered palæozoic slates, frequently near their junction with eruptive rocks, whether of igneous or of aqueous origin;" and this statement is singularly corroborated by the position of this quartzose vein under notice, which traverses altered palæozoic slates near the junction of an eruptive bar of porphyritic greenstone; and the same law I find to obtain from careful observation with respect to all the gold-bearing quartzose veins in the Dolgelly district. The St. David's lode, referred to, has had a shallow adit driven on the course of it for about fifteen fathoms, and several rich "bunches" or "strings" of gold have been taken therefrom. This adit was partly driven many years since, and much of what was then called "poor copper ore" was raised. Some of this "poor copper ore" was sold at Liverpool at an advance of 5*s.* per ton on the current price—for a reason perhaps known to the smelters, who expressed a wish to be allowed to have more of it. In 1854, the grass-grown refuse of this ore was examined by a friend of mine, and large stones were found showing rich incrustations of native gold. Many stones were several pounds in weight, and had gold disseminated throughout. Some of these stones are on the table. One stone was afterwards raised from the lode, broken up, stamped, and sold in a state of powder for 25*l.* On another occasion, 100 lb. weight of quartz yielded 14½ oz. of fine gold. The veinstuff has been experimented upon for limited periods by several persons since the discovery of 1854; and several shoots, strings, or bunches of gold obtained equally rich; but owing to the uncertain operations of amalgamating machinery on the one hand, and the mines themselves being the subject of two chancery suits on the other, the general value of the lode in bulk has not yet been ascertained. It is, however, quite

certain that much more gold has been obtained from the lode than would cover the cost of driving the said fifteen fathoms of ground.

Whether this discovery of gold will eventually prove of commercial value or not remains to be proved. There is a singularly interesting array of facts in favour of such a probability. Arrangements have recently been made with the Crown to work this "Royal Mine." Operations were recommenced on the 28th ult. upon the St. David's lode, and about 15 cwt. of stuff broken down. Upon examination many of the stones were found to be very rich in gold, associated with galena, sulphides of copper and iron, and a doubtful mineral called at present "white metal." Several eminent mineralogists have had samples of it to examine and to name; and it is not a little remarkable that there is no unanimity amongst them as to its name. I have been ridiculed for not knowing its name; but as I know its value in two important respects I am content to laugh in my turn and pocket the intended slight. Some of the stones are exceedingly rich; but for private reasons I beg to be excused any estimation of their value. I produce one stone, weighing 10 lb., an average sample, brought purposely to illustrate this paper as to the occurrence of gold with copper ore. A companion stone, weighing 4½ cwt., is now in London, and appears to have gold disseminated throughout; and what is more satisfactory, the lode as it now stands appears equally rich. Gentlemen may form their own estimates of value: my present object is to deal with the geological and mineralogical facts. It was my intention to have read to the society in January last a paper of greater length, containing observations on the various modes of extracting the precious metal: but the Commissioners of Woods and Forests, after perusing a draft of the said paper, laid claim to my specimens on behalf of the Crown. I had no alternative in self-defence, but to refrain from the publicity of the facts. I have now to beg the society to accept a printed copy of that paper, and a specimen of the average produce of the gold lode under notice as it at present stands.

An interesting discussion ensued. The first point taken up was the new and nameless "white metal." The following additional facts were mentioned: — It contained about one-third gold, and was the index to the presence of the precious metal. Cubes of this white metal were found in cubes of gold, and *vice versâ*, wherever this white metal was found, gold was sure to be visible. Mr. Readwin described an interesting and novel process of reducing the ore, and stated that gold, like other metals, would volatilise, or rather escape mechanically, at a certain temperature, though such was not the general belief. None of the members were able to name this white metal.

The Chairman remarked that Mr. Readwin would be fortunate if he added a new simple substance to the forty or fifty already known. Mr. Readwin said that he had no expectation of that kind; but that he had in his cabinet gold ores from all parts of the world, but there was nothing amongst them at all akin to this. Mr. Atkinson stated his reasons for believing that gold was sublimated from the earth below by internal heat. The other metals were seldom found "native," like gold. Mr. Readwin would express no opinion just then as to the origin of gold, his attention had been given mainly to its modes of occurrence and extraction; but he could not help feeling a little pride at having established the fact that gold followed the same law of produce as other metals.

CORRESPONDENCE.

Adulteration and its proposed Remedy.

To the Editor of the Chemical News.

Sir,—After consideration of my recent article on the above subject[1], and some friendly criticisms, induce me to trouble you with a few additional and explanatory words. In the table of food and its adulterants, the object sought was *not* that of publishing a series of startling and exceptional facts, but merely to present to your readers a fair and unprejudiced statement of what our "food and drink" is, every day, and throughout the year, really and systematically contaminated with. I have purposely avoided unnecessary details, for the simple reason that the pages of a scientific journal should never be encumbered by matter not absolutely essential. On this account both *water* and *salt* were omitted in the list; — the first, because it is never purposely *adulterated* by the parties supplying it (although it is too often very imperfectly purified from negligence), the latter in consequence of no falsified sample having, to my knowledge been sold since the abolition of the duty. Again, it has been remarked that some adulterants are noted as simply more or less *injurious* at one part of the table, while at another they appear in capitals, denoting them to be poisonous; thus, *vinegar* is adulterated with "*sulphuric acid*," while the same ingredient is marked poisonous when added to *gin*: — this is not an error, as has been supposed by some; for owing to the comparatively small amount of vinegar individually consumed, the acid-adulterant is never taken in sufficient quantity to endanger human life, while in the case of gin, the presence of sulphuric acid is by no means safe where large quantities are imbibed, especially by persons characterised by habitual intemperance.

Various patent and other prepared goods I have been compelled to exclude from personal motives; for although well aware of the numberless frauds perpetrated in this department, not only by agents (who use false packages, and imitate the *labels* and *trade marks*[2] of the genuine preparations, for which various cheap, spurious, and frequently injurious matters are substituted), but even by the manufacturers themselves, I do not feel inclined to risk a score of legal "notices of proceedings," as the penalty of informing your readers that "Popkins' Patent Peruvian Corn Flour" was adulterated with wheaten starch and bad oatmeal, by Obadiah Pyzinem, of High Street, somewhere, or that the "*Alga Africanus*, or African Grass Cocoa," is anything but what it professes to be, and is decidedly inferior to the ordinary varieties.

I think I have now said enough in explanation of the apparent omissions in the table referred to.—I am, &c.

Wentworth L. Scott.

Brompton, London, S.W. Oct. 1860.

The Pharmaceutical Society.

To the Editor of the Chemical News.

Sir,—My attention has been drawn to a note signed "F. B. Benger," in last Saturday's Chemical News, p. 226. In my son's absence from London will you kindly allow me to do what I am sure he would hasten to do, viz. admit and regret the error into which you have been led. The certificate of merit bestowed upon my son Alexander Waugh, was in the Class of Botany and Materia Medica (Pharmaceutical Society).—I am, &c.

George Waugh.

177 Regent Street, Oct. 24, 1860.

The Repelling Power of Carbon and other Bodies.

To the Editor of the Chemical News.

Sir,—We know that all material substances attract, and there is perhaps reason for supposing that all exercise a repulsive power under certain conditions. It is remarkable to find that carbon repels not only water but also light, which fact may be shown by blackening a piece of iron or any other metal, by any flame, and placing it under water, when all its sides will present a silvery appearance. When any metal is plunged into a vessel of mercury, there is reason for supposing that absolute contact does not exist, and similarly we

[1] Chemical News, Vol. II. pp. 148, 198, 199.

[2] An interesting paper *On Trade Marks* was read at the Society of Arts' last session, by Professor Leone Levi.

may here imagine that the carbon does not absolutely touch the water, and consequently that the light is also repelled from it, and the brilliant surfaces are the inner films of water, from which all the incident light is reflected. I see that Mr. Williams, in his work *Through Norway with a Knapsack*, has brought forward this experiment in connection with the supposed existence of the Norwegian sea-serpent; but I do not think that more can be made of it than I have here noticed, that is, that it can be otherwise explained. The leaves of roses, as I suppose is a popular observation, repel water and light, when their surfaces are not altered by being rubbed or pressed, apparently in the same manner; and this is rendered more probable by the fact that the surfaces of the two substances alluded to differ greatly in colour. It will probably be supposed by some that our present knowledge enables us to affirm that they also differ much in other ways, but I do not hesitate to say that our knowledge of surface phenomena does not allow us to decide that there is much if any difference between the surface of a blackened nail and that of a rose-leaf.

If a small quantity of any liquid is injected through the mercury into the upper part of the barometer column, it at once disappears, and the mercury simultaneously falls. I take this to be as remarkable a phenomenon as any to be found in the whole range of chemical science. If the disappearance did not occur in a vacuum, it might be imagined that the vaporised liquid was dissolved into or diffused throughout the atmosphere, but here this idea cannot of course be held. We find that a liquid is converted into vapour, and that this, according to its quantity and density, exercises pressure upon the mercury. We might have supposed *à priori* that the vapour of any liquid would under the above conditions exercise some, if not a palpable amount of pressure, that is if we had imagined its formation; but that any liquid would under any conditions where heat is absent be converted into vapour is, I apprehend, a question which could alone have been decided by the method of experimental enquiry. The latter fact is before us, and it cannot but be useful to attempt some explanation of it. It is surely too much to suppose that the diffusion of the liquid particles, for this is what constitutes vaporisation, is, so to speak, made upon the matter, assuming this of light or heat; and it is impossible to suppose that any fluid ever assumes a vaporous condition without the action of some repulsive force. If it was granted that the vapour was diffused throughout the matter, or either of the matters, supposing that two exist, above mentioned, it would still be necessary to explain how the liquid was converted into a vaporous state. The allowance would be useless, for while the vapour of water is in various ways diffused throughout the atmosphere, this is not necessary for its diffusion, and consequently no supposed matter is necessary for the diffusion of any vapour throughout an atmospheric vacuum. It must, I think, be decided that the mercury exercises a repulsive force upon the enclosed liquid, and that this causes it to become vaporous. When it is considered how powerfully mercury either repels or is repelled by most bodies, as shown by its curving downwards when placed in a vessel of glass, or between plates of the same material, or when the finger is dipped into it, there is no difficulty in understanding that when relieved from the pressure of the atmosphere in one direction it exercises the force here attributed to it. I have been careful in speaking of the nature of mercury, but, inasmuch as it can never be supposed to repel, except in the sense of repelling itself from any body, as is seen in its curving downwards and sinking below its level when flowing upwards from any vessel into a small tube, it may be said that mercury is always repelled when any repulsive force is witnessed; for to affirm that any substance repels itself from any other, is the same as to say that the latter repels it. The experiment alluded to appears to me to prove that mercury is capable of exercising a repulsive force. — I am, &c.

J. A. Davies.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

The Passivity of Iron. — When a piece of iron is placed in ordinary nitric acid it is violently attacked; if it be withdrawn, the acid adhering to the surface continues its action. If now we wait until the adherent acid is saturated, and then again plunge the iron into nitric acid, the coating of rust which has been formed dissolves, the iron becomes of dead white colour, and is no longer attacked by the acid—it has, says M. Saint Edme [1] become *passive*. If the iron be rubbed it becomes attackable again, and may be brought back into the passive state in the same manner as before.

Iodine in the Atmosphere. — M. Chatin [2] insists that there is iodine in the atmosphere. He has found it in the rain water of Florence, Pisa, and Lucca, as at Paris. Further, he adds he has found it in 5 samples of distilled water, and 3 specimens of potassium from the best laboratories, and he believes that it may be found in all potassiums and most rain waters. M. Chatin cannot succeed in isolating the iodine, but he is none the less certain of its presence.

II. ORGANIC CHEMISTRY.

The Ethers of Glycide and their relations with the Glyceric Ethers. — In a long and interesting memoir by M. Reboul [3], which deserves attentive study, that chemist announces his belief in the existence of an oxygenated body $C_6H_6O_4$ which he regards as the anhydride of glycerine $C_6H_8O_6$, from which it differs by 2 equivalents of water, and which he names *glycide*. This body, he says, is to glycerine what lactide is to lactic acid, and the amides are to ammoniacal salts. Glycide, being the anhydride of a triatomic alcohol, ought to resemble a diatomic alcohol, and therefore possess two series of ethers represented by the general formulæ

$$1\,C_6H_6O_4 + A - 2HO$$
$$2C_6H_6O_4 + A + A' - 4HO.$$

This idea M. Reboul has worked out with great skill and patience, and has embodied the results in a long paper which he ends by drawing the following conclusions:

1. That compounds exist connected with an oxygenated body $C_6H_6O_4$ which may be regarded as ethers.

2. Those of the first series, viz. those with 1 equivalent of acid or alcohol, are derived from the second series of the glyceric ethers by the loss of 1 equivalent of an hydracide. In this way M. Reboul has obtained the following bodies:—

	Glycides.	
(1)	Hydrochloric . .	$C_6H_5ClO_2$
	Hydrobromic . .	$C_6H_5BrO_2$
	Ethylic . . .	$C_6H_5(C_4H_5)O_4$
	Amylic . . .	$C_6H_5(C_{10}H_{11})O_4$.

The hydriodic glycide, $C_6H_5IO_2$, alone has been obtained by double decomposition.

3. Those of the second series are derived in the same way from the glyceric ethers of the third series. In this way the following ethers have been prepared:—

	Glycides.	
(2)	Dihydrochloric . . .	$C_6H_4Cl_2$
	Dihydrobromic . . .	$C_6H_4Br_2$
	Chlorohydrobromic . . .	C_6H_4BrCl

4. The last-mentioned compounds, by uniting with 2 equivalents of bromine form the following bodies:

$$C_6A_4Cl_2Br_2\ C_6H_4ClBr_3\ C_6H_4Br_4$$

5. In uniting with hydracides, the first mentioned ethers give by synthesis mixed glyceric ethers of the second series: in this way the following new compounds have been obtained:

[1] *Comptes-Rendus*, t. li. p. 507. [2] *Ibid.* 496.
[3] *Annal. de Chim. et de Phys.* t. lx. p. 1.

Glycerines.

Chlorohydrobromic . .	$C_6H_6ClBrO_2$
Chlorohydriodic . . .	$C_6H_6ClIO_2$
Bromohydriodic . . .	$C_6H_6BrIO_2$
Dihydriodic	$C_6H_6I_2O_2$
Amylhydrochloric . .	$C_6H_6(C_{10}H_{11})ClO_4$
Amylhydriodic . . .	$C_6H_6(C_{10}H_{11})IO_4$
Ethylhydrochloric . .	$C_6H_6(C_4H_5)ClO_4$

6. They also combine with alcohols and give mixed glyceric ethers, identical with those obtained by the preceding method.

7. With oxyacids and water they form by synthesis glyceric ethers already known; acetohydrochloric glycerine for example.

8. Glyceric ethers with 2 equivalents of alcohol may be obtained from associated alcohols (*alcohols sodés*) and glyceric ethers, with either 1 equivalent of an hydracid and 1 equivalent of alcohol, or with 2 equivalents of the hydracid. In this way the author has prepared:

Ethylamyglycerine .	$C_6H_6(C_{10}H_{11})(C_4H_5)O_6$
Diamylglycerine . .	$C_6H_6(C_{10}H_{11})_2O_6$

9. Those which contain only 1 equivalent of the alcohol result either from the double decomposition of the companion alcohols and the glyceric compounds with 1 equivalent of the hydracid:

Ethylglycerine . . . $C_6H_7(C_4H_5)O_6$

or by the fixation of water on the alcoholic ethers of glycide:

Amylglycerine . . . $C_6H_7(C_4H_5)O_6$

10. Beyond these the author has isolated a chlorinated compound, $C_{12}H_{12}ClNO_4$, and a sulphurated body of the mercaptan kind, $C_6H_6S_2O_2$.

LABORATORY MEMORANDA.

The separation of Silver from Galena.—The usual mode of separating the silver contained in lead ore or galena, is by reducing the whole to the metallic state, and then oxidising the lead in a particular kind of furnace; and this is done either with or without the use of the crystallising process of Mr. H. L. Pattinson, according to circumstances. But by this means a considerable loss occurs both in lead and fuel. To prevent this loss, I have for some time successfully employed a method of separating the silver from the galena itself, which I will now describe.

Galena consists, as is well known, of the sulphuret of lead, mixed with a variable proportion of the sulphuret of silver, and both these substances fuse together, or melt at a bright red heat. Now, it so happens that, when sulphuret of silver is fused with chloride of lead, what is called a double decomposition takes place; that is to say, chloride of silver and sulphuret of lead are formed. Consequently, if we fuse together a quantity of argentiferous galena and chloride of lead, we shall remove the whole of the silver from the galena, and replace it by sulphuret of lead. This, then, is my new process: I mix together the galena and chloride of lead in the proportion of 100 lbs. of galena, 1 lb. of chloride of lead, and 10 lbs. of chloride of sodium or common salt; or, if the galena be very argentiferous, I add a larger amount of chloride of lead. The whole is then fused together, when the chloride of silver and common salt rise to the surface, and may be skimmed off, and the desilverised galena falls and may be run out from the bottom. The mixture of chloride of silver and salt may then be decomposed by lime and charcoal, or in any other manner, so as to reduce the silver and a portion of the surplus chloride of lead, by which a metallic mass will result, suitable for the operation of the "cupell."—*Bubhil.*

MISCELLANEOUS.

Chemical Society.—The first meeting of this Society, for the present session, will take place at Burlington House, on Thursday next, November 1, at 8 p.m.

Tuscan Marbles.—I know of no Oolitic marbles in Tuscany, but of the Cretaceous group may be mentioned the Campiglese pink and pale red varieties, more properly limestones. To this period belongs the celebrated and widely used *Portoro*, of the Island of Palmaria and Porto Venere, on the western promontory of the Gulf of La Spezia, near the confines of Modena and Piedmont. The village of Porto Venere, bombarded during late wars, and still half in ruins, is of great antiquity, having been known to the Romans as *Portus Veneris*. I should imagine it highly probable that they employed the beautiful marbles so near this place. A great convulsion which has occurred, and has been so ably described by Sir Roderick Murchison, may now be more easily studied than formerly, for half way to La Spezia, and near the newly erected arsenal is a lofty conical hill crowned with a fort; the strata have been laid bare from the base to the summit by the engineers, who are constructing a military road up the hill. The marble is chiefly black, with bold yellow veins, and may be obtained in very large blocks. Seldom does it ever fall to the lot of the geologist to have natural sections so admirably supplemented by human art as here, where the strata of hard limestones verging on marble are seen alternating with thin beds of softer rock, and the violent upheaving power may be traced to perfection; in one part of the valley, forming a large synclinal axis, the strata inclining on either side at an angle of 60° with the horizon; further down, the distortion increasing, the lower beds are actually turned over on the upper."

Quartz in Marble.—By far the most interesting mineral is the quartz, which crystallises in the cavities of the marble, sometimes attaining one inch in length. It is perfectly limpid, whence the name *Carrara diamonds*. Some which I procured enclose foreign substances. I observed that in general they presented a very small point of attachment to the rock. These numerous associated minerals are eagerly sought for by the quarrymen, as they accompany the best statuary marbles. They are known as *Madremacchie* (mother spots). Some fissures thus filled up are several inches in thickness, others do not exceed one line in width, and contain a few scattered crystals of iron pyrites, firmly imbedded in the marble on one side. It is due, I consider, to the oxidation of these crystals that, on exposure to the air, the marble is discoloured and tinged reddish-brown.—*Jervis.*

Composition of Carrara Marble.—All the true Carrara marble is obtained from eight quarries, their names being:—"Betogli, Crestola, Carpevola, Cavetta, Mossa, Polvaccio, Poggio Silvestro, and Zampone. The marble is almost pure carbonate of lime. Berthier (*T. des essais*, tom. 1. p. 614) gives the analysis:—

Lime	55·4	or, Carbonate of Lime .	98·1
Magnesia	0·4	Carbonate of Magnesia	0·9
Carbonic Acid . .	43·2		
Clay and Quartz . .	1·0	Clay and Quartz .	1·0
	100·0		100·0

Wooden Substitutes for Whalebone.—Many unsuccessful attempts have been made to obtain a perfect substitute for whalebone for the manufacture of the ribs of umbrellas and parasols. A Mr. Ball has found that by selecting the butt end of white oak timber, of what is termed the "second growth," and of straight rib and free from knots or curls, and, in no case, using more than six feet from the ground or stump, and subjecting it to a certain process of curing, it is made to serve not merely as a substitute for whalebone, but is converted into an altogether superior article, as it is not only tougher and possesses greater tenacity than whalebone, but the ribs made from it always resume their straight condition after exposure to the weather.

Melting Zinc by Gas.—The melting of zinc, which is generally performed in plumbago crucibles over a coke fire, requires an elevated temperature that is difficult to regulate. If the temperature becomes too high, it causes a loss of zinc by evaporation and burning, and it also seriously injures the quality of that which remains; the oxide of zinc resulting from combustion mixing mechanically among the metallic mass and producing what is termed burnt zinc. This accident occurring daily in zinc foundries, aroused the attention of Mr. Miroy to the advantages of employing gas in this operation. His apparatus consists of a cast iron crucible placed upon an upright cylinder in a conical furnace, where the gas is burned. This furnace is formed of two concentric envelopes of iron plates, separated by a layer of sand; or it may be made of fire brick. The gas is brought in obliquely from the two sides by two pipes, each concentric to a larger pipe, leading compressed air; the gas pipes being $\frac{6}{10}$ of an inch in diameter, and the air pipes being $2\frac{8}{10}$ inches. Mr. Miroy estimates that the volume of air employed should be triple that of the gas, and this proportion is regulated by stopcocks in the pipes. The air is forced into the pipes by a blower driven by power. The melting by gas is more rapid and less costly than the fusion by coke, especially when a crucible has to be mounted for a single melting. There is also a great saving in the cost of crucibles.

The Relation of Science to the Industrial Arts. When the gyroscope was introduced a few years since, to the attention of the community, it was regarded as a scientific toy, and no one ever dreamed that it could ever be made of any use in the practical affairs of life. This fact illustrates the relation between pure science and industrial art which has indeed been abundantly proved, but which is not, by any means, generally recognised. "What is the use?" is the very common question when some great but apparently barren discovery is made in abstract science. Hidden in his obscure laboratory, among his retorts and crucibles, the chemist is intently engaged in ascertaining the relative affinity of oxygen for sodium and for aluminium. The practical man passes by with a sneer at this utter waste of intellectual labour. The chemist plods on a few years, and lo! the world is endowed with a new metal, of rare, peculiar and invaluable properties. Learned geologists meet and dispute, almost with fierceness, the relative ages of certain rocks which were deposited in the bottoms of unknown seas in the immeasurable ages of the past. "How utterly useless!" says the legislator, engaged in the discussion of railway bills and other measures of immediate necessity. But this science also vindicates its claim to utility; and all bodies of legislators find that there is no more profitable employment of the public money than in having geological surveys made of their respective States. The most surprising instance, however, of pure science proving useful to man is furnished by astronomy. The heavenly bodies are so immensely distant, so absolutely unapproachable, that it must have been impossible to conceive that a knowledge of them could ever be of any practical value to the world. How certain must have been the money making merchant of early times that the star-gazer was a useless cumberer of the earth! But this knowledge of the heavenly bodies is the thing which guides the merchant's ships in safety over the seas, and brings his cargoes to their profitable market. It is irrational to say that any item of knowledge, however abstract or remote from the common affairs of life, may not be turned to useful account in some of the complicated operations of modern art. Among all the evidences of design and benevolence which are afforded by the works of creation, there is none more impressive than the wonderful variety which characterises the human race. Some men like to pass their lives in roaming over the ocean, and others in tilling the earth; to many is afforded a peculiar gratification in the accomplishment of difficult undertakings or the triumphs of mechanical skill, while a select few find the purest and highest enjoyment in the pursuit of abstract knowledge, without any reference whatever to its application to the affairs of life. In organised society these several tastes find each its sphere of action, and thus science and the industrial arts labour harmoniously together, both alike conducive to the improvement and well being of the human race.

Remarkable Spring.—The Silver Spring, in Marion county, Florida, rises in a basin 30 feet deep, and pours out a stream large enough for steamers to ascend. Other basins along the stream showed nearly the same depth to the limestone crevices from which new springs boiled up. The marvellous property of the spring is the transparency of the water. It seemed, on looking down, as though the plumb bob could be seen just as distinctly under 36 feet of water as it could be through as many feet of air. Experiments on reading cards fastened to bricks, proved that printing could be read at as great a distance under the water as in the air. The vertical depth of the water seems to the eye very much exaggerated, especially under the boat, so that without measurement the bottom appears continually to recede under you as you float, and to appear under your boat about 50 feet deep, and to rise around on every side. The spring is very steadfast in its flow, and receives no surface water.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Un Étudiant.—Berzélius' *Traité de Chimie*, although now rather old, is one of the best books in the French language which a student can take up with the object of being thoroughly grounded in the elements of the science.

One of our first Subscribers is thanked for the suggestions. The Professor has now in preparation a course of lectures, the particulars of which we will announce in an early number, which will not be of so elementary a character as those now in progress. We propose to give full reports of these, and may possibly issue them as a supplement, so as to avoid occupying too much of our space.

G. Rodgers.—We have handed your letter to a manufacturer of the article, who will doubtless communicate with you direct.

Reginald L.—1. In none that we know of. 2. Fresenius. 3. Normandy's *Handbook of Commercial Analysis*. 4. None known to us.

Alkahest.—1. Consult Plattner *On the Blowpipe*. 2. Common tin solder, using a solution of chloride of zinc instead of rosin.

Vol. II. of the Chemical News, containing a copious index, will soon be ready, price 8s. 6d. handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. if sent to our office, or, if accompanied by a cloth case, for 6d.

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THE ADULTERATION OF FOOD.

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THE CHEMICAL NEWS.

VOL. II. No. 48.—November 3, 1860.

BUILDING-STONES AND PRESERVATIVE SOLUTIONS.

[FIRST ARTICLE.]

HOWEVER inventors may dispute, and scientific men may differ, as to the respective values of the solutions intended to preserve building-stones from decay, they, as well as Parliamentary Committees and architects, are unanimously of opinion that the continued durability of the principal of our public buildings depends on chemistry. The question is one of grave importance; not merely on account of the pecuniary considerations involved, though they are of enormous magnitude; but the character of the nation is concerned in its ability to erect buildings which shall endure to future ages. The present condition of that splendid monument of the late Sir C. Barry's genius—the Houses of Parliament—is even more serious than is generally supposed. Not only do the ornaments crumble and decay, and the surfaces of the stones yield to atmospheric influences, but there is reason to apprehend that this disintegration extends to internal portions of the walls. It is not long since a policeman had a narrow escape of being killed by the falling of the canopy of the niche in which the statue of Charles II. is placed, and the cause assigned is the decay of the stone. The susceptibility of the stone employed in this building to moulder on exposure to the atmosphere is aggravated by the elaborate ornamentation to which it has been subjected. In the case of the flat surfaces, we are told that care has been taken, as far as possible, to hew the stone in such a way as to expose that side to the air which is most capable of resisting its influence; but, as regards the sculptured portions, such precaution was manifestly impossible; hence the reason why these portions exhibit the greatest amount of decay. Considering how large a proportion of the external surface consists of these ornaments, it is clear that if this crumbling becomes universal, their restoration will be almost tantamount to the re-erection of the building, which, seeing the enormous sum that has already been expended, is a contingency which may well make the economists who sit within its walls to tremble.

Before we consider the different preservative solutions which are proposed to remedy this tendency to decay in certain stones, we will briefly describe the nature of those which are available for architectural purposes; so that the causes of decay and the mode of preservation may be better understood. Among the stones which promise the greatest degree of durability is granite; not that it is entirely unsusceptible of alteration, since the crystals of felspar contained in it are liable to decomposition from the action of the carbonic acid held in solution in rainwater. But if this were the only objection to its use, we should attach little importance to it, the vertical position of the stones in a building rendering it impossible for the rain to remain on them sufficiently long to exercise a seriously injurious action, the roughening of the surface observable in very old erections of this material being attributable rather to the mechanical action of the falling rain, than to a chemical action arising from the carbonic acid contained in it. There is, however, a more serious objection to the employment of granite than this, and this is its cost. Of course this does not arise from any scarcity of the material, but from its excessive hardness, which renders it difficult to work; and for the same reason it could not be employed in buildings of a florid style of architecture. There are freestones, which are scarcely inferior to granite in hardness and durability, but these very qualities tend to prevent their general use. The Crayleith-stone, which is a good deal used in Edinburgh, is of this kind. It is composed of fine-grained quartz and mica, cemented together by a hard, siliceous compound. A similar kind of stone is that used in paving London streets, which is got chiefly from Yorkshire, and is very hard. It is a laminated stone, and is liable to flake off when exposed to the wet. There is an instance of this tendency to be seen at the south-east corner of Victoria Square, where the action of the water has had full opportunity of developing itself, with little interference from other causes, very few people indeed walking over it. These sandstones are of different qualities, some being much harder than others; but their lamination would prevent their use in buildings where the ornamentation was elaborate, even if there were not the further objection of hardness. Moreover, in the case of those where carbonate of lime or clay forms the cement which binds the particles of quartz and mica together, the impurities contained in the rain which falls over large cities readily act upon them by dissolving the cementing medium, and, consequently, destroying the adhesion of the particles of which the stone is composed.

Some of the best building materials at our disposal are the limestones. First in beauty is marble; but its scarcity, and consequent dearness, renders it unavailable for general purposes. Still it may be questioned whether, if it had been foreseen that the Houses of Parliament were to begin decaying before they were finished, it would not have been cheaper in the end to have built them of this stone, seeing that it does not absorb water, and is not acted upon by it unless it contains an acid, so that decay is a thing hardly to be thought of. As to the difficulty of obtaining it in sufficient quantity, that might have been overcome by resorting to other countries. We import considerable quantities of Caen-stone from Normandy, and the expense of freight would not be greatly increased by sending vessels to the Mediterranean, close to the shores of which marble could be quarried to almost any extent. Resembling marble, but containing veins of foreign substances which both weaken it and interfere with its working, is the stone termed by geologists carboniferous limestone, but more commonly Portland-stone. This was used by the late Sir C. Barry for the beautiful building he erected at Birmingham, known as King Edward's Grammar School, the design

of which is similar to that of his great work at Westminster. It has stood for twenty-five years without showing any signs of decay, except on the undersides of the cornices, string-courses, and projections in the bed-joints, arising from the drip of rain. The quarry from which this was taken is the Darley Dale, and we are assured, by an authority on whom we can rely, that no stone used in Birmingham has withstood the action of the gases contained in the air so well as this. If we judge by experience of the durability of stone, which, after all, is the best test, we presume there are few who will deny that Portland-stone is that which, in this country, should be employed for our public buildings. Look at Somerset House, some of the City churches, and Greenwich Hospital. They do not offer any signs of decay, notwithstanding the length of time which they have been exposed to the influences of the weather. The composition of this stone is almost identical with that of marble, that is to say, almost pure carbonate of lime.

Caen-stone differs in quality, like all others. Some specimens are to be found in good preservation which have withstood the wear of centuries; others, again, have decayed almost immediately on removal from the quarry. We have a striking example of this in Buckingham Palace, which was no sooner finished than portions of it had to be removed and stucco substituted in its place, and to prevent the spread of the evil, the whole front has been painted. Bath-stone, which was that selected by the Dean and Chapter for the restoration of portions of Westminster Abbey,—rather, as we think, on account of the ease with which it could be carved than by reason of its cheapness,—is the worst of all. True it is that buildings can be pointed out at Bath which were built of this stone a century ago, and yet are in good condition; but these stones may have lain in the quarry exposed to the air for months before being used, and anybody who desires to see the difference which this makes in the hardness of the stone, has only to cause a block which has been left under these circumstances to be turned over, and then try the point of his knife alternately on the side which has been exposed to the air and that which has been in contact with the ground. Probably everybody has heard of the rapidity with which the restored parts of the Abbey reverted to their original condition.

Magnesian limestone is that used in building the Houses of Parliament. When thoroughly crystallized it contains equal parts of carbonates of magnesia and lime, and in this state is generally very durable. The Commission appointed to select the stone were shown buildings composed of magnesian limestone from Bolsover, which had stood for ages, and they decided in favour of the same material. So far they were justified in their selection; but it may be questioned whether, when it was found that this quarry did not contain anything like sufficient stone for the purpose, a similar stone from other quarries should have been accepted, without first submitting it to a rigorous examination. There can be no doubt that had proper care been taken in inspecting each block as it was hewn in the quarry, and it had been properly hardened by exposure to the air, and protected from rain, the present alarming condition of the building would never have arisen. The absorbent properties of these stones facilitate the action upon them of the gases contained in the atmosphere; and it is only just to mention that the Houses of Parliament and the Abbey have been more severely tested in this way than any other of our public buildings, from the quantity of gases vomited from the chimneys and factories on the opposite banks of the Thames being borne across to them whenever the wind does not blow in a contrary direction. The result of this action shows itself very rapidly in those parts of the stone where the crystallization is not complete: they become soft, and are ultimately reduced to powder. Of course the proper way of guarding against this accident is to reject those blocks in which the crystallization is imperfect; and, though this would involve increased expenditure in the erection of a building, it would be sound economy to do so.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the Water of Ben Rhydding, Yorkshire, by Sheridan Muspratt, *M.D., F.R.S. Ed., &c., Professor of Chemistry, Liverpool.*

It is a remarkable fact that no analysis of this water has hitherto been published. For some years now Ben Rhydding has been famous as a hydropathic establishment, which is ably conducted by Dr. Macleod, and to which thousands of persons annually flock for the purpose of enjoying its bracing air and partaking of its pure, cool, and refreshing water. The establishment at Ben Rhydding is very finely situated on the slope of Rombald's Moor, about seven miles from the famous Bolton Abbey. It is at an elevation of five hundred feet above the level of the sea: it is erected on an arenaceous soil, and rain never lies on its gravelly walks. The springs which supply it with water are among the finest in Great Britain. From its situation, midway between the vast upland moors and the sweet banks of the placid Wharfe, Ben Rhydding affords not only a favourable position from which to admire the varied scenery around, but one from which, by a walk requiring little time or exertion, the valetudinarian may enjoy what he desires,—an agreeable change of temperature. As a matter of course, it is everything *combined* at such a place that produces the beneficial results upon the patients; the water no doubt acts a most important part in many skin, kidney, and other diseases, applied externally or internally. The water flows from the principal fountain, which is called the "Shrine," at the rate of about three gallons a-minute. It has a temperature of 42°, and is exceedingly refreshing and cooling to the palate. Although it contains a little more fixed matter than the Malvern water, which I analysed last year, still, being rather colder, it seems to exert a more invigorating effect upon the partaker. Annexed are the results of the solid constituents in a gallon of the water. The composition appears to me rather a singular one as compared with that of other waters of a salubrious nature throughout the Kingdom. The specific gravity of the water is 1.00129.

	Grains in the Imperial Gallon.
Carbonate of Lime . . .	merest
Carbonate of Magnesia . .	traces.
Chloride of Sodium . .	0·914
Chloride of Magnesia . .	trace.
Sulphate of Lime . . .	2·295
Sulphate of Soda . . .	0·511
Silicate of Potassa . .	1·315
	5·035

On looking at the above figures, the water appears to consist almost entirely of a silicate and a calcareous sulphate.

On the Spontaneous Decomposition of Chloride of Lime, by A. W. HOFMANN, *Ph.D., F.R.S.*

ONE morning (I think it was in the summer of 1858), when entering my laboratory, which I had left in perfect order on the previous evening, I was surprised to find the room in the greatest confusion. Broken bottles and fragments of apparatus lay about, several window-panes were smashed, and all the tables and shelves were covered with a dense layer of white dust. The latter was soon found to be chloride of lime, and furnished without difficulty the explanation of this strange appearance.

At the conclusion of the Great Exhibition of 1851, M. Kuhlmann, of Lille, had made me a present of the splendid collection of chemical preparations which he had contributed. The beautiful large bottles were for a long time kept as a collection; gradually, however, their contents proved too great a temptation, and in the course of time all the substances had been consumed. Only one large bottle, of about 10 litres capacity, and filled with chloride of lime, had resisted all attacks; the stopper had stuck so fast that nobody could get it out; and after many unsuccessful efforts—no one venturing to indulge in strong measures with the handsome vessel—the bottle had at last found a place on one of the highest shelves of the laboratory, where for years it had remained lost in dust and oblivion, until it had forced itself back on our recollection by so energetic an appeal. The explosion had been so violent that the neck of the bottle was projected into the area, where it was found with the stopper still firmly cemented into it.

I have not been able to learn whether similar cases of the spontaneous decomposition of chloride of lime have been already observed in chemical laboratories; but have since heard from M. Kuhlmann that they occasionally occur in chloride of lime factories. The cause of these explosions, it need hardly be remarked, is the accumulation of oxygen gradually evolved from the bleaching powder.

TECHNICAL CHEMISTRY.

On the Preparation of Steel by Cementation, by M. H. CARON.

THE processes employed for the cementation of iron vary according to the composition of the "cement powder," but all the methods of operating are similar; the piece to be cemented is placed in a sheet iron box, surrounded with coal-dust, soot, carbonised leather, horn, etc. Each method has been extolled by those who employ it, but an explanation of the rationale has heretofore remained undiscovered. In striving to account for this phenomenon, it has occurred to me that the combination of iron and carbon could not take place without the intervention of a compound gaseous carburet, which, penetrating the pores of the metal dilated by heat, there abandons its carbon.

Now, from the nature of the cements employed in the manufacture, this compound ought to be a cyanide. To establish this, I have made the following experiments. The apparatus I use consists of a porcelain tube filled with coal, broken into pieces the size of a centimetre square. In the centre of the tube, and in the direction of its axis, a square bar of iron is placed, which is thus completely surrounded with coal. The tube is placed in a small laboratory reverberatory furnace, and heated with coke. The apparatus thus disposed, I cause hydrogen, carbonic acid, nitrogen, air, and pure carburetted hydrogen, &c., to pass successively through the tube, heated to redness; but after heating it for two hours, I have never once succeeded in producing the phenomenon of cementation. Sometimes, and in a few places, the surface of the iron was a little harder; but in all these instances the cementation, always superficial, was attributable to the impurity of the carbon or gas.

It is otherwise if, instead of these gases, I pass dry ammoniacal gas through the tube; the cementation in the latter case is rapid and complete. After two hours' heating, the bar of iron is tempered, hammered to condense the grain, and again tempered, when upon fracture it is found cemented to the depth of two millimetres, perfectly regular and of excellent grain. To what is the cementation attributable? Evidently to the action of ammonia on carbon; these two bodies at this temperature, would form a gaseous cyanide of ammonium, which yielded its carbon to the iron and thus formed steel.

Still, this was only a hypothesis, and I wished to verify the direct action of cyanide of ammonium: to this end I did away with the carbon in the porcelain tube, and left nothing in it but the iron placed in its axis, and sustained in this position by its two extremities. I prepared in a retort some cyanide of ammonium, which I passed in a dry gaseous state through the porcelain tube made red-hot. After two hours' heating, the bar of iron was submitted to the same operations as in the former experiment, and was then found to be well cemented, and more thoroughly at the extremity where the gas entered than at the other. After this I have concluded that the cementation is produced by the cyanide of ammonium.

The ammoniacal gas,—or, rather, the cyanide of ammonium,—cannot alone possess the property of cementing, and it is more than probable that the other alkaline cyanides possess it also. Tempering by means of prussiate of potash, so well known in commerce, is a proof of it; but, unfortunately, the cementation in this case being always superficial, cannot be compared to the other process. Consequently, I have been obliged to employ other means to establish the fact of cementation by alkaline cyanides.

Having disposed my apparatus as before, I steeped the coal in a weak solution of carbonate of potash, and passed a current of dry air through the red-hot tube. It is known that under these circumstances the cyanide of potassium which is formed is perceptibly volatile at a red heat.

It is on this body I relied for the cementation of iron; indeed, after subjecting the bar to the fire for two hours, it became thoroughly cemented to the depth of two millimetres. Soda, baryta, and strontia effect the cementation almost in the same way under the influence of a current of air. Lime, as I anticipated, produced no cementation, and thus furnished additional support to my hypothesis of cementation by the cyanides. For many years I have been engaged in the preparation of alkaline cyanides by the dry method. To obtain them, I pass dry ammoniacal gas through a red-hot tube filled

with coal; I conduct the cyanide of ammonium thus formed into another red-hot tube containing lumps of charcoal saturated with the base of which I wished to prepare the cyanide.

I thus very easily obtain cyanides of potassium, sodium, barium, and strontium, but I can never produce cyanide of calcium, magnesium, &c. Lime, unlike baryta, being unable to form a cyanide under the influence of nitrogen and carbon, should not be adapted for cementation if my hypothesis is true. The presence of an alkaline base, as has been shown, does not suffice to produce cementation; it is requisite that this base should, under the circumstances, form a cyanide. If no cyanide is formed, no cementation results.

All the more or less strange receipts employed in manufactories for cementing iron, are intelligible upon the hypothesis of the formation of cyanides. Prepared charcoal always contains potash or soda; the animal matters which are added yield the nitrogen which helps to produce cyanide.

To sum up, it appears to me that these experiments demonstrate in an indisputable manner that, to obtain a deep and rapid cementation, the formation of the alkaline cyanides I have named must be provided for in the coal surrounding the iron. The application of this method is easy; perhaps, also, the time occupied in the process could be shortened, and thus greater tenacity be ensured to the central part of the metal than has hitherto been obtained by cementation.

Notices of Some of the Patents taken out for the Preparation and Use of the New Dyes, generally known as Fuchsiacine, Violine, Purpurine, Roseine, Magenta, &c., &c., with Remarks on them.

In our seventh Number we noticed several patents on the above and kindred subjects, viz.:—

Perkins, for purple, by bichromate of potash and sulphate of aniline.

Beale and Kirkham, for purple, by hypochlorite of lime and salts of aniline.

R. D. Kay, for colours produced by the action of the peroxides of manganese and lead on the salts of aniline.

David S. Price, for the same, or nearly the same process.

Williams, for reds and purples produced by manganates and salts of aniline.

Perkins and Gray, for mordants for the mauve.

In the notice alluded to we entered more especially upon the discussion of the greater or less degree of practicability attached to the various processes. We now renew the subject, looking upon it from other points of view, namely, those of dates and similarity.

We fear our list is not so full as it should be; nevertheless, we think a discussion of those before us will not be without great interest for a considerable number of our readers. In the following table will be found the dates of the patents, the names of the patentees, the

Date.	Patentee.	Substances claimed to act on the Aniline.	Name of Substance found, and Tint.
1859.			
April 12	Brooman (Renard Frères)	Anhydrous bichloride of tin, bichloride of mercury, perchloride of iron, protochloride of copper	Fuchsiacine; red.
May 25	D. S. Price	Peroxide of lead and sulphate of aniline	Violine; purpurine; roseine
Oct. 27	Brooman (Renard Frères)	Bichloride of titanium, bibromide of tin, bibromide of mercury, iodide of tin, hydrated bichloride of tin ..	Fuchsiacine.
Nov. 1	W. H. Perkins; provisional only	Perchloride (bichloride) of mercury	Red.
Nov. 28	Brooman (Renard Frères)	Sulphate of tin, sulphates of mercury, bifluoride of tin, bifluoride of mercury, nitrate of uranium, nitrate of peroxide of iron, bichloride of titanium, bibromide of mercury, bibromide of tin, iodides of tin, chlorides of uranium, bromate of mercury..	Red.
Dec. 3	C. L. Smith (Schlumberger)	Metallic (*sic*) iodine and iodides of metals, especially biniodide of mercury	Red.
Dec. 10	Rudolph Heilman (Keller); provisional only	The salts formed by the nitrogen oxyacids (such as nitric acid, hyponitric acid, and nitrous acids) and metallic oxides; the salts formed by the oxyacids of sulphur (such as sulphuric, hyposulphuric, and sulphurous, and the metallic oxides). The salts formed by the oxyacids of chlorine, bromine, and iodine (such as perchloric, chloric, iodic, bromic; and the metallic oxides); the salts formed by the oxyacids of phosphorus and the metallic oxides; the salts formed by the oxyacids of arsenic and the metallic oxides; the salts formed by the oxyacids of chrome and the metallic oxides. The metallic oxides alone or combined with one of the above-mentioned acids or an organic acid. The following acids: manganic, permanganic, ferric, plumbic, antimonic, antimonious, alone or in combination with bases	
1860.			
Jan. 18	H. Medlock	Dry arsenic acid	Azaleine.
Jan. 25	E. Nicholson; provisional only	Strong solution of arsenic acid	Reds and purples.
March 5	Richard Smith; provisional only	Solution of chlorine in water..	Colour not named.
			Reddish colouring matter, like that obtained from aniline with chromates.

substances used to act on the aniline, and the name and tint of the colour formed.

The previous table gives, at a glance, the essence of ten patents. It will be seen that several persons patent the same, or nearly the same processes. In many instances, where the ingredients are different, the process is chemically so nearly the same that disputes and appeals to a jury will probably be the too frequent result. Unfortunately, in almost all cases of alleged infringement of chemical patents, juries are quite unable to comprehend the real bearing of the facts and opinions offered by the witnesses; so that, however "glorious" (?) may be the uncertainty of the law generally, the uncertainty of the law as specially applied to chemical patents, is so far greater as to defy all calculation.

In a future article we shall glance at the chemistry involved in the processes comprised in the above table.

It will be seen that aniline reds are produced in a vast number of reactions. Nine-tenths of the substances claimed are, however, entirely useless in practice.

Mr. Perkins did not proceed with his patent, probably from the fact of his having been forestalled by Renard Frères.

M. Schlumberger, of Mulhouse, is also too late, iodides having been included in Renard Frères' specification of October 27.

Keller's communication is simply absurd. He patents chemical re-agents right and left, and most of the substances claimed yield no colour at all with aniline and its congeners. He might as well claim organic and inorganic substances generally as sources of colouring matters. It is worthy of observation that he claims bromates, but is anticipated in this by Renard Frères (November 28). Considering the wholesale way in which oxy-acids are claimed by him, it is not remarkable that he should mention salts of the oxy-acids of arsenic, one of which (in the free state, however) is claimed in the next two patents. To claim the oxy-acids of chrome, after Perkins' patent, is an inconceivable absurdity. He has also claimed manganic and permanganic acids, which have been patented previously in this country.

Medlock's patent for dry arsenic acid is uncomfortably close to Mr. E. C. Nicholson's for strong solution of arsenic acid. The latter patent, however, was not completed.

Mr. Richard Smith, of Glasgow, patents solution of chlorine in water. Not only is this process of an unpractical character, but it is forestalled by Beale and Kirkham's patent of the 13th May, 1859. It is liable to all the objections urged by us against the latter.[1]

We wish it to be understood that we do not for an instant doubt that beautiful colours can be produced by the processes claimed by Mr. Smith. We merely record our opinion that, on the large scale, they would be found too troublesome and expensive. It is unnecessary, however, to discuss Mr. Smith's mode of operating, as his patent was not carried beyond the provisional specification.

PHARMACY, TOXICOLOGY, &c.

On the Influence of Arsenious Acid upon the Waste of the Animal Tissue.[1]

According to experiments made by Prof. Schmidt and Dr. Stuerswage, of Dorpat,[2] arsenious acid, when introduced into the circulation, occasions a considerable diminution of the ordinary waste of the tissues.

This decrease, which amounts to from 20 to 40 per cent., occurs even after the administration of very small doses; more rapidly if the acid is injected directly into the veins; more slowly, yet with equal intensity, if absorbed from the intestines. The action is most striking in the case of fowls, which neither vomit after injection of the arsenic nor reject their accustomed food; but even in cats, which are subject to vomiting after the injection, and must therefore be regarded as in a starving condition, the waste of the organism was diminished about 20 per cent. after subtracting the decrease occasioned by the mere want of food.

This fact satisfactorily explains the fattening of horses after small doses of arsenious acid,—a phenomenon well known to horse dealers.

An amount of fat and albuminous substances equivalent to the repressed carbonic acid and urea remains in the body and increases its weight, if the animal receives at the same time a sufficient amount of food.

When larger doses of arsenious acid are given nervous symptoms appear, which may be classified in two groups,—spinal iritation and paralysis. To the first may be referred the vomiting, the accelerated respiration, the feeble pulse; to the last, the inclination to sleep, the weakness, and the retarded and laboured breathing. Both may be explained by the very considerable congestion of the central organs, which was constantly observed in post mortem examinations.

These experiments are of particular interest, since they go far to prove the complete reliability of the published accounts of the custom of "arsenic-eating" which is said to prevail among the peasantry of several Austrian provinces. These accounts have been time and again held up to ridicule by toxicologists[3] and, as a rule, have been received with suspicion by all scientific men. They have nevertheless been widely published, and are consequently well known to the public.

During the last eight or ten years the origin of these accounts has been generally attributed to Dr. v. Tschudi, who published a communication upon the subject in 1851,[4] an abstract of which may be found in *Chambers' Edinburgh Journal*, December 20, 1851 [N. S.], No. 416, p. 389.[5]

Two years later, v. Tschudi made another communication[6] in support of his previous assertions. This, in connection with his first letter, which had previously attracted comparatively little attention, was very extensively copied.[7]

Similar stories had been circulated, however, long before the letters of v. Tschudi were made public. For

[1] Chemical News, No. 7.

[2] From the *American Journal of Science*, vol. xxx. No. 89.

[3] *Journal für praktische Chemie*, 1859, lxxviii. p. 373.

[3] See, for example, Christison, *Edinburgh Medical Journal*, Feb. 1856, i. 709. A. Chevallier, *Journal de Chimie Medicale, &c.* 1854, [3.] x. 439. Or Taylor, in his work "On Poisons." London: Churchill, 1859, p. 91.

[4] *Wiener medizinische Wochenschrift*, Oct. 11th, 1851, vol. i. No. 28.

[5] From which it was copied into Wells's "Annual of Scientific Discovery," 1852, p. 362.—"Hays's *American Journal of the Medical Sciences* for July, 1852, vol. xxiv. p. 270, also contains extracts of v. Tschudi's letter, taken from the French *Gazette des Tribunaux* through the *Journal des connaissances Méd. Chirurg.*, December 16th, 1851.

[6] *Wiener medizinische Wochenschrift*, 1853, No. 1.

[7] *In extenso* in *Journal de Chimie Médicale, &c.* 1854 [3.] x. 439; from *La Presse Medicale Belge*; from *Journal de la Societé des Sciences médicales et naturelles de Bruxelles*; abstract in *Chambers' Edinburgh Journal*, June 11th, 1853 [N. S.] vol. xix., No. 493, p. 382.

An abstract of the first (1851) letter in the *Gazette des Hôpitaux*, of Paris, May 16, 1854, p. 229, from *Journal de Médecine de Bruxelles*, (see also the London *Medical Times and Gazette*, July 1854, xxx. 66,) is perhaps the best known of any of the numerous extracts from v. Tschudi's statements, unless it be that given by J. F. W. Johnston in his "Chemistry of Common Life," New York, Appleton, 1855, i. 166; also in *Blackwood's Magazine*, December 1853, lxxiv. 687.

example, our own attention was first directed to the subject by the statement published in the *Penny Cyclopædia* of the Society for the Diffusion of Useful Knowledge, London, 1832, ii. 403; Art. "Arsenic, Medical Uses of." * * *

"That its [white oxyd of arsenic] employment in such doses [$\frac{1}{20}$ or $\frac{1}{12}$ of a grain] as we have stated is not only safe but beneficial, may be satisfactorily proved. Not only are old, worn-out horses endowed with new vigour, improved appetite, &c., by its use, but pigeons to which this article is given, show greater appetite and liveliness than others without it; and in Upper Styria the peasantry use it as a seasoning with many articles of food, such as cheese." * * *

In the *Boston Medical and Surgical Journal*, 1835, xii. 211, is the following:—

"Dr. Strohmayer, in his 'Medicinische praktische,'[8] relates, in exemplification of the extent to which the system may become accustomed to the operation of arsenic, that a peasant who resided near a convent in the Tyrol, for a long time took ten grains of arsenic daily with his food." * * *

In noticing the article in *Chambers' Journal*, for 1851 a correspondent of the *London and Edinburgh Monthly Journal of Medical Science*, February, 1852, xiv. 190, cites the following extracts:—

"From Vogt's[9] 'Arzneimittellehre,' B. i. s. 507:—It is well known that old, worn-out horses gain an appetite, strength, and spirit, by the use of arsenic; and a pigeon which often got arsenic was observed to have its appetite increased and its movements more lively."

"From *Med. Jahb. des Oëster. Staates*, 1822, s. 99:—There is scarce a district of Upper Styria in which, in at least one house, arsenic may not be found under the name of Hydrach, Orpiment, &c. It is used for diseases of the domestic animals, against vermin, and also as a stomachic to increase the appetite. A peasant, in my presence, showed, with the point of a knife, how much arsenic he took daily, and without which he said he could not live. I estimated the quantity at about two grains. It is also said to be used as a seasoning for cheese, and, indeed, several cases of poisoning by Styrian cheese have occurred, and one but lately."

Similar statements made by Wibmer (probably in his book entitled "Die Wirkung der Arzneimittel, u. Gifte im gesunden, thierischen Körper," 4 vols., Munich, 1831-39), are referred to in German works upon the materia medica; while travellers who have spent much time in these provinces, all concur in their statements regarding the common custom of mixing arsenic with the food of horses.[10]

In calling attention to the subject some months since (*Répertoire de Chimie Appliquée*, February, 1860, ii. 44), we took occasion to bring forward the observation of Prof. E. Kopp,[11] who found in the course of his experiments upon arsenic acid—which was manufactured upon the great scale, and largely employed in calico-printing by him—that the weight of his body rapidly increased, some 20 lbs. having been gained in the course of two months, during which he was subject to absorb the acid, his hands having been frequently in contact with the arsenical solution: arsenic being detected the while in his solid and liquid excrements. As soon, however, as the exposure to the arsenic ceased, his weight began to decrease, and in the course of nine or ten weeks fell back again to its normal 150 lbs. Believing that direct positive evidence like this,—though the instance be solitary,—where the subject of the experiment was a healthy, vigorous man, and a trained observer, ought to outweigh almost any amount of negative testimony, such as has been brought forward by physicians who have not witnessed similar effects upon their *diseased* patients when the latter were treated with arsenical preparations. It should be observed that one of the strongest arguments brought up by toxicologists against the truth of the accounts of the arsenic-eaters has been drawn from the result of medical practice. Without attempting to discuss the matter at length, it may, nevertheless, be permitted to the non-professional reader of the medical literature bearing upon this subject to remark that the evidence there accumulated, in spite of its apparent obscurity, and of the contradictions with which it is involved, seems to point clearly to the fact that in minute doses arsenious acid acts beneficially upon the general health of many patients. Thus, according to Dr. Henry Hunt:—[12]

"Arsenic operates most favourably on persons who are of lax fibre, accompanied by a languid state of the circulation, and whose secretions are rather profuse than otherwise; the urine pale and plentiful, and more especially on those whose skin is cold and moist. In persons of this description, whilst arsenic, to an extent far beyond other medicines, relieves the neuralgic pain, it improves the general health, and gives firmness and vigour to the constitution." * * * While upon certain peculiar temperaments it is hurtful; thus Dr. Hunt continues, "when neuralgia is associated with the same morbid action in the spine, with anæmia; or arises from injuries of nerves; or local irritation of nerves by diseases, or unnatural growth of bone; or if it be complicated with engorgement of the liver and other viscera; arsenic is usually injurious, and I believe seldom useful."

Again, not to multiply instances further, Erichsen,[13] in treating of the use of arsenic in diseases of the skin, "lays great stress upon the necessity of attending particularly to the constitution and temperament of the patient before commencing the use of the medicine. It will be badly borne by individuals of a plethoric habit of body or of a highly sanguine or sanguineo-nervous temperament; this arises from the stimulating properties of the metal. In such cases, the digestive organs become so irritated, and the nervous system so excited under the use of the arsenic, that it is impossible to employ it in any such dose as can be expected to produce a beneficial effect upon the cutaneous affection. There are other circumstances which contra-indicate the use of this remedy, namely, 'the complication of the cutaneous affection with other diseases,' and especially with irritative or inflammatory gastric dyspepsia, accompanied with a sensation of heat and oppression at the epigastrium, increased by food, so well described by Dr. Todd. When this form of dyspepsia is present the smallest doses of arsenic will do harm, as the usual effect of the remedy when continued too long is to produce these very symptoms. Besides this form of indigestion, any other local inflammatory condition of the system or the superinventiom of phthisis, will contra-indicate the use of so powerfully stimulating a tonic as arsenic." Further on he remarks:—"It has already been shown that the use of the preparations of this metal is

[8] Quere? Strohmayr, Frz. *Medicinische praktische Darstellung gesammelter Krankheitsfälle, u. des Heilverfahrens aus dem Tagebuch meiner Erfahrung Wien, Gerold*, 1831.]

[9] [Quere? Voigtel, Fr. G. *System der Arzneimittellehre*, Leipsig, 1816.]

[10] A custom which seems also to prevail to a certain extent in England. Compare Kesteven, cited by Taylor, (*op. cit.* p. 89,) from the *Association Medical Journal*, Sept. 6 and 20, 1856. We have to regret our inability to refer to K.'s original paper, the tenor of which is not readily to be inferred from Dr. Taylor's extracts.

[11] *Comptes-Rendus*, 1856, xliii. 1063; *J. pr. Ch.* lxix. 273.

[12] In his work upon Neuralgic Disorders, cited in Braithwaite's *Retrospect of Pract. Med.*, 1844. No. ix. p. 34; also, *ibid* No. x. p. 23.

[13] Braithwaite's *Retrospect of Pract. Med.*, 1843, No. viii. p. 14.

exceedingly hazardous in individuals of a sanguine or sanguineo-nervous temperament and excitable habit of body, or in those who suffer from or are peculiarly disposed to irritative gastric dyspepsia, or any inflammatory disorder. On the other hand, they are in most cases borne well by individuals of a somewhat phlegmatic, debilitated, or lax habit of body, more particularly if they are past the middle age, with a pale, cachectic complexion, languid weak circulation, and a general want of tone about the system, acting upon such patients as powerful and useful tonics. In persons of this habit of body the diseases of the skin appear rather to be dependent upon a degree of debility or want of power in the cutaneous capillaries; and it is in these patients that the preparations of arsenic are of great service in exciting in a peculiar manner a more healthy action in this class of vessels, thereby modifying or removing those morbid changes that are the results of an abnormal condition in their secernent and nutrient functions."

In this connection it must not be forgotten that, in the opinion of many scientific men, the healing action of various mineral waters may depend, in part, at least, upon the arsenic which these springs are known to contain,[14]—a doctrine which is publicly taught by several of the chemical professors at Paris.

Taken as a whole, the medical evidence which has fallen under our notice is adverse to the possibility of "arsenic eating," only in so far as relates to the large quantities of poison which, as is affirmed, the human body can accustom itself, by long-continued habit, to support with impunity. This last inquiry, however interesting in itself, is one on which very little is known with certainty as yet, and is plainly of quite secondary importance, in a scientific point of view, to that of the beneficial action of moderate doses of arsenious acid, which would now appear to be proved. From the very general interest which attaches to the subject it is greatly to be hoped that further researches may soon decide the amount of this tolerance. F. H. S.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On Food, by EDWIN LANKESTER, *M.D., F.R.S.*

LECTURE II. *On Salt and other Mineral Constituents of Food.*

TO-DAY, according to the announcement in the prospectus, I wish to bring before you what I have called the Mineral Constituents of our Food,—to which, generally speaking, we attach very little importance. Persons who prepare our food—cooks in the kitchen, ladies who superintend cooks and order dinners for large families, and people who consume food from day to day,—never think of asking whether food contains mineral constituents in the right proportions to secure health, and without which babies get rickets, young ladies get curved spines, fathers get gouty, and mothers get palpitations; and they do not think of ascribing these to the food which has deprived them of the proper mineral constituents. I think I can show you that the importance of this consideration can hardly be overrated.

In order to illustrate the importance of these things, I must show you the elementary constitution of human beings. Suppose we take a human being put him in a retort, and apply heat to him: we shall find that, first, 111 lbs. of water will actually rise up from a body weighing 154 lbs.; and the next thing that comes off will be carbonic acid gas; then there will be ammonia; and then you might get a little sulphuretted hydrogen and phosphuretted hydrogen, and gases of that sort; but you will at last get a quantity of ashes. Now, in the water you get the oxygen and the hydrogen. In the carbonic acid gas you get carbon and oxygen, and in the ammonia you get nitrogen and hydrogen. In the ashes which are left we get phosphate of lime, carbonate of lime, fluoride of calcium, chloride of sodium, sulphate of soda, carbonate of soda, phosphate of potash, sulphate of potash, peroxide of iron, phosphate of iron, phosphate of magnesia, and silica. These are the things of which I shall have to talk to you to-day, without which we cannot live. And if you will persist in having only refined sugar and the whitest flour, rejecting the brown; if you will persist in rejecting the salt and avoiding the liquor in which meat is boiled, you may get albumen and fibrine, but none of these mineral substances; and then the first attack of fever or cold may prove fatal. Four men shall be travelling outside of an omnibus,—one may get acute inflammation of the lungs, another bronchitis, and the other two shall come off free. Was it the riding outside of the omnibus that did it? No; it was the state of their blood. They had lived somehow irregularly. So you may find half-a-dozen children all exposed to the contagion of scarlet fever; two take it, one dies, and the other four are free; but the two that have caught it have lived in such a way that their blood has readily taken in the contagious disease; and the one that has died has got in such a condition as to produce death. Hence the importance of attending to these subjects thoroughly,—not getting a little knowledge of them, but a knowledge of what is necessary to the feeding of men. If not, we shall somehow or other suffer.

Now, I shall just take up these constituents according to their importance, and, probably, according to your general knowledge of them. You cannot expect me to go into an exhaustive chemical analysis of this subject, and I may say we are not in a condition to do so. But I will go into it as well as I can in the time allotted. I have taken up the first substance—Salt. That is the only substance which we take directly from the Mineral Kingdom. All the other things we get through plants or animals; but Salt is a substance which we take direct from Nature to satisfy the demands of our system. Now, this salt is composed of two substances—chlorine, a gas, and sodium, a metal. These two substances combined together, constitute this salt, which you know determines the life and forms of things in the ocean. Withdraw the salt from the ocean, and you will have none of the life which now exists there. Herrings, mackerel, cod-fish, and all the forms of fish that we get out of the sea would retire, and we should then have the fish of our rivers, such as roach, dace, and the other varieties. Thus you see how this salt influences life, and the form of life. We get it for our use from the sea, and from those deposits of salt which the sea has left. When obtained from the sea, the sea-water, containing from 400 to 500 grains of salt to the gallon, is evaporated. But the sea in former times has formed bays, and those bays have been gradually silted up, and the land has retired from the bay, and the bay now becomes a lake. This lake is a salt lake. We have many such salt lakes. The Dead Sea is a salt lake, removed a long way from the sea, like the salt-beds in our new red sandstone in Cheshire.

Now, not only do the animals that live in the sea require salt, but man requires it also. We find that man bears a tax on his salt, and we find this the most convenient way of taxing India for the last century, and I believe that tax is still continued; and man must and will have his salt. Now the question comes as to how this salt acts upon the system. How do we know anything about its action? You see here is the quantity of it contained in a human body that weighs 154 lbs. It is not much, 3 ounces and 376 grains; but you see it is a good

[14] Compare Walchner, *Ann. Ch. u. Pharm.*, lvi. 206; or *Comptes-Rendus*, xxiii. 614. Figuier, *Comptes-Rendus*, xxiii. 820. Chevallier and Schanefele, *ibid.* xxv. 750. Thenard, *ibid.* xxxix. 769.

deal if compared with the other things. When we take away the phosphate of lime and the carbonate of lime, we have only left about 10 ounces more of the ashes, and of those 10 ounces the chloride of sodium, or salt, is 3¾ ounces. Now the question is where this salt exists. If you take the muscles or the nerves of animals you do not find that they contain salt; but if you take the blood you will find it there. I do not wish to produce upon your minds any disagreeable reflection, but those of you who have tasted your own blood must recollect that it tastes of salt. We find three drachms of salt in a gallon of human blood; and that is the quantity in nearly all animals. Now you may ask, What good can it do? You may be sure that it does good. There are some people who are foolish enough to believe that man has been wrong in all ages, and that salt has done wrong. There was one gentleman who died because he thought salt was the forbidden fruit that was eaten in the Garden of Eden. He died a very few months ago, as I understand, quite a victim to his folly. Now if I were to take a vessel and divide it into two parts by a membrane such as is in our own body, and put salt and water on this side and spring water on the other side, when they were first put together they would be level, but in the course of time you would find that the spring water would go down and the salt and water would rise and flow over. Well, this is effected by a process which we call endosmosis, and which is greatly assisted by the presenc of this chloride of sodium, or common salt. There is no other means of introducing chlorine into the system than through the medium of chloride of sodium, and we find that the chlorine becomes separated from the metal. We find in the gastric juices that there is a quantity of hydrochloric acid consisting of hydrogen and chlorine. Then, it seems to facilitate certain changes in the system which are beneficial to health, which are difficult to explain exactly, though I will just say that an experiment of this kind has been performed. Two sets of oxen have been taken by a great French chemist. He fed one set with, and one set without salt. For a short time there appeared no difference; but at the end of a month the cattle that had the salt were sleek and well-favoured, while the others were rough and in bad condition; and so it went on for two years, and, on the whole, there was no doubt that the healthier animals were those who had the salt.

If you take a very small quantity of hydrochloric acid and salt, and put it into water, and put the white of egg into the water to which you have added the hydrochloric acid and salt, and then expose it to a temperature of 98°, it begins to dissolve; but if you put it into the water without the salt it does not dissolve. So that you see there is this first action; in small quantities it assists digestion; so that you see the propriety of adding small quantities to our food. There are some persons who will not take it, but those persons are preserved by the cook putting it into puddings and cooked meats, and the baker putting it into the bread. Now, I need not, I think, dwell further on salt. I have notes here, showing how very early in past ages mankind directed attention to salt. We find that the Jews used it in their sacrifices. The Arabs put it on the table as a mark of hospitality; in Abyssinia he carries it in his pocket, takes out a lump and offers it to a friend to lick as a mark of respect and esteem. Then the Hindoos swear by their salt, and many of you may recollect that during the late war in Hindostan, when the English officer wanted to bring the guilt home to the delinquent, he said, "Remember, Sir, you swore by your salt to defend the Queen of England," and so on. Then again, it was a mark of distinction in England in the olden time: persons who sat above the salt were higher in dignity than those who sat below the salt. I will just say, finally, that although we may, by preventing its getting into food, take too little, yet there are provisions for getting rid of an excess.

The next thing is the phosphate of lime, which forms the principal part of the earthy matter of the bones. Of this phosphate of lime, there are 5 pounds 13 ounces in a man weighing 154 pounds. Now this phosphate of lime must be a very important thing, or it would not occur in such large quantities. I draw your attention to it in the first place as constituting the earthy matter of bone. If we suppose that there are 5 pounds 13 ounces in the system, at least 4½ pounds of that will be contained in the skeleton. I shall have occasion again to refer to the composition of bone; but bone contains about 40 per cent. of gelatine, 50 per cent. of phosphate of lime, 10 per cent. of chalk, and 1 per cent. of fluoride of calcium.

I should give here a very wrong idea of the importance of this phosphate of lime, and especially of the phosphoric acid which is contained in it, if I left you to suppose that the only important thing was its existence in relation to the lime in the bones; for the fact is, we find phosphoric acid in the blood, in the brain, and in the nerves, in a free condition. It is introduced into the system as phosphate of lime, or perhaps phosphate of soda, or phosphate of potash; but during the changes, we find phosphoric acid playing a very important part. Now that is an important thing to recollect, because we may be constantly taking a diet which excludes the necessary phosphate, or taking a diet in which it abounds. If we have it in too large a quantity, we are almost sure to kill ourselves: no sort of medicine that I know of will in any way correct this. Now how do we get those phosphates? I have shown you that this phosphate of lime is the most important, but other phosphates are found in the system,—phosphate of potash and phosphate of magnesia, for example. How do we get these? There are two sources of phosphates in our food. The first source is found in the cereal grasses, and the second in animal food. When I say cereal grasses, I mean all those grasses which belong to the grass order of plants eaten by man. Wheat is the most important; but barley, oats, rye, rice, maize, all contain phosphates. Animals, you know, eat grass of various kinds, and they thus get into their system these phosphates, and when we eat the blood, the nerves, and the muscles of animals, we eat phosphates. It is in wheat bread that we get the largest quantity. Now, a very interesting question has arisen out of our recent knowledge of these facts, and that is, What is the best way of supplying those necessary phosphates to the human body? and it has been found that the best way is from these grasses. But those grasses must have the phosphates before the animals themselves can have them, and it was pointed out by the great German chemist, Liebig, that one of the great drawbacks on the growth of wheat was the want of phosphates in the soil, and one of the great drawbacks in the development of animals and of man was the want of phosphate in the food which they eat. This has led to the discovery that we may apply phosphate of lime, not merely by the agency of animal and vegetable manure, but by the agency of what are called artificial manures. By means of these this phosphate of lime is supplied to the plant, and from the plant we receive it into the system, as we need it for the sustenance of our own bodies. There is one question which I will just mention here, which is of some practical importance. How do plants get a supply of phosphate of lime? That explanation will give you an idea how it is that certain substances act upon our own systems in conveying certain phosphates to our blood. I told you in my last Lecture that carbonate of lime was soluble in water containing carbonic acid gas: so is phosphate of lime, and, when the water comes down to the earth which contains this phosphate, it actually dissolves it, and then the little plant can take up the water and the phosphorus, and apply it to its own use. So in the same way, if we take it into our stomach, and add to our food carbonic acid gas, we assist the solution of those phosphates. Thus if is

that we prefer liquids which contain carbonic acid gas in them, and the taking of carbonic acid gas is found by experience to be beneficial. Thus we take bottled beer, which contains a considerable quantity of carbonic acid gas; we take champagne, which owes its sparkling properties to the carbonic acid gas.

Now, I must leave the phosphate of lime, important as it is, and call your attention to a third group, which are the Salts of Potash. Just as we find sodium in plants that grow in the sea, we find potash in plants that grow away from the sea. Those plants contain large quantities of potash, and hence the name potash, from the fact that wood which is used for boiling the pot contains this in its ashes, and, hence these ashes are called "pot-ashes." Now, there are some plants which are called potash plants, and I do not know a more important practical point than that certain plants contain potash, and that the exclusion of these from diet is a very bad thing. Potatoes contain potash; now I do not know whether any of you have speculated upon the reason why Europe should have seized with such tenacity upon that plant which is foreign to its shores; but there are philosophical writers who trace the cessation of plague and other epidemical visitations to the use of the potato. When we come to examine the potato we find it contains not so much starch as rice, and very little nutritive matter. It seems that, at the first glance it was a matter of very little importance whether we ate potatoes or not as long as we got flesh-forming substances; but here are these ashes in the proportion of 1 per cent., and what are they principally?—Potash. The quantity of ashes in a pound of potatoes is not much; but that quantity seems to be explanatory of the great fact that the health of Europe has improved since the potato has been eaten. Other vegetable foods—asparagus, radish, turnips, carrots, parsnips,—are "potash plants," and all those who exclude these things from their diet do wrong; they also do wrong who throw away the water in which they are boiled. It is better to make vegetable soups of the water and let children be encouraged to take them. Watercresses may be eaten by them, and lettuce, chicory and endive, and a variety of salads when they can be got fresh; and, when they have been dried, these things may be used in the form of soups, with carrots, turnips, and such like. I was lecturing on this subject a little while ago, and my friend Dr. Noad informed me that he had made an analysis and found that water, after boiling one pound of potatoes, contained 17 grains of carbonate of potash, and the sulphate which he obtained from cabbages was 21 grains, and he found the same with regard to carrots; and if he had gone through the whole range he would have found, I have no doubt, salts of potash in all of them. I would not advise you to substitute carbonate of potash from the doctor's shop for the potatoes, cabbages, water cresses, and those things, although I believe, medicinally, that that substance sometimes saves a man's life.

If you feed men on chloride of sodium, and do not give them salts of potash, you will give them a disease which more than decimated our navies up to the year 1780, —scurvy. That disease broke out in the utmost intensity during the potato famine, and although the people were supplied with rice and other things, the disease went on; thus showing that the potash alone could arrest certain changes that went on without it.

In the year 1780 Sir Gilbert Blane discovered that lemon-juice would cure scurvy, and now, since that time, if a ship goes out for six weeks without lemon-juice or lime-juice, a fine of 5*l.* a-day is incurred. The worst part of it is that ships are sometimes supplied with something which is not lime-juice at all, but sulphuric acid and water. It is not the acidity that is wanted, but it is a citrate of potash that is required.

There are one or two other considerations that are very interesting. Thus if you take potash with citric acid, the citric acid is destroyed and the potash remains in the tissue. Destroyed, how? I shall show you, when we come to the next Lecture, that starch and sugar are not unlike citric acid, and the way in which they act is to supply animal heat.

I come now to the carbonate of lime. Well, that is an important thing. Not so important, perhaps, as the other two, but when I tell you we have got 1 lb. of it in our 154 lbs. you will see that there is quite a sufficient quantity of it to make it of importance, and I could not say that phosphate of lime would make up for carbonate of lime. We get it from the water we drink. I showed you in our last Lecture that nearly all the water we got from wells contained carbonate of lime; but there are a number of plants which contain considerable quantities of carbonate of lime. Beans and peas contain it, and also clovers and vetches, and plants of that sort, which only grow on chalk soils. When we take it in the form of the water which we drink, then we take it dissolved in carbonic acid, which I referred to just now.

There are some other substances to which I have not yet referred: Peroxide of Iron is one. It exists in very small quantities—in not more than 150 grains in the human body. Now that substance is contained in the blood, and that small quantity seems to be necessary to the health of our body. We meet with persons with pale faces indicative of the want of iron; we administer iron, and they recover their good looks and their roses, and all arising from the iron getting into the blood. The French are sometimes in the habit of performing the process of incremation on their dead friends—that is to say, they burn them instead of burying them,—which is a much more wholesome process. The Romans burnt their friends, and collected their ashes in an urn; but the Frenchmen,—and they would not be Frenchmen unless they could improve upon the old Roman plan,—after burning their friends, take their ashes, and extract the iron from them, and convert it into a ring to wear in memory of their dead friends.

I have nothing further to say with regard to the iron, than that it may be supplied medicinally.

Now, then, there are some other substances which are perhaps not so material. Here is Silica, which you see exists in the small quantity of three grains in the human body—it is distributed in the nails, but more especially it is found in the enamel of the teeth. Teeth have a coating of enamel, which is formed of a certain quantity of silica, so that you see it seems to be necessary to the comfort and welfare of man. Again, we find that Magnesia exists commonly in the soil of Scotland. It is taken up by the oat-plant, and conveyed to the blood of Scotchmen, and Scotchmen have been found to contain magnesia in their blood.

If you do not get enough iron, then almost any of these metals will supply its place. Even mercury will supply its place for a time, and every man is the better for taking a blue pill now and then. Copper has also been found in human blood, but that is accidental; but it appears that we are in the habit of eating pickles, and bought pickles frequently contain copper, which is added to them to make them green and inviting to the eye. Throughout Europe there is a quantity of these coppered pickles consumed.

Then there is this beautiful substance Iodine, which exists in a solid body at the ordinary atmospheric temperature, but is vaporised at a higher temperature; and this exists in the sea-water, with chloride of sodium and bromine; and thus it appears that it occasionally enters into the human system, and it is found in small quantities in the human breath—and there has been a dispute whether it exists in the human body. Now, this iodine has been found in the bodies of Frenchmen, but not in the bodies of Genoese; and this accounts for the fact that the Genoese have *goitre*. This bronchocele, or swelling of the glands of the neck, is called *goitre*; and this is the

substance which, in the Frenchman, prevents him getting *goitre*, when he is among the Genoese, who are suffering extensively from this complaint. This disease is common among the Swiss mountains, and the Pyrenees. There are individuals in our country who are constantly suffering from this enlargement of the neck, and we know that this iodine is a remedy. It has also been found in watercresses, especially those watercresses which grow near the sea. I have recently examined some watercresses in London that had none.

I have shown you that in cooking you are very likely to get rid of these mineral constituents. In cooking care must be taken against throwing away the water. The substitute is salads, or raw fruit, and thus we take oranges, of which children can hardly take too many. Then, soups and stews, in which the salt has not been thrown away, are good,—as also are preserves, whether in oil or sugar. You preserve their mineral constituents; and if you apply these practical hints, you will be better in health.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 2, 1860.

Dr. Joule, President, in the Chair.

The President brought under the notice of the meeting a sheet of copper, upon which, whilst under magnetic influence, iron had been deposited electrolytically. The experiment was made by Mr. F. H. Hobler, of London, as follows:—The plate of copper, forming the bottom of a shallow vessel filled with a saturated solution of sulphate of iron, was placed on the poles of a powerful horse-shoe magnet, fixed vertically with its poles uppermost. An iron wire, dipping into the solution, was placed in connection with the positive electrode of a Daniell's cell, of one pint capacity, the copper plate being connected with the negative electrode. The deposited iron exhibited the lines of magnetic force in the same manner as in the case of iron filings scattered on a sheet of paper placed over a magnet. When Mr. Hobler substituted a plate of tinned iron for the copper, he observed indications, though very faint ones, of the same phenomenon. On using a saturated solution of sulphate of copper, Mr. Hobler observed that the deposit was even throughout, and that no specific position of the axes of the crystals of copper could be detected, although they invariably formed on the outside of the two poles. Mr. Hobler, in discussing the phenomenon, inquires whether it is produced by the action of the magnet upon the solution in direction of the lines of force, or whether the iron is formed in the solution immediately above the copper-plate, and then attracted by the magnet into the direction of the lines of force. The former suggestion appears to him to be inconsistent with our present knowledge of the influence of magnetism on chemical action; the latter, with the theory of electro-deposition, which supposes the coating to be formed on the plate, and not deposited, strictly speaking, thereon.

The President exhibited a slip of paper which he had received from Professor Thomson. On the paper was printed by photography the line indicating the various changes of atmospheric electricity, which took place at the Observatory of Kew during twelve successive hours. Much interest was excited by witnessing one of the first-fruits of Professor Thomson's beautiful instrument. The paper indicated a series of very rapid oscillations, about one per minute, of the intensity of atmospheric electrical force.

Mr. Henry Bowman presented a statement of observations on the temperature of the six summer months ending September 30, 1850, taken by a self-registering thermometer at Victoria-park, Manchester.

Mr. Dyer having stated that on the morning of August 11, a very loud explosion was heard in the neighbourhood of Blackfriars, London, the sky being clear at the time, a conversation took place on the subject of fire-balls and meteorites, in the course of which Mr. Ekman stated that during a most violent thunderstorm, passing over a tract of land intersected by a rapid stream, he had distinctly seen fire-balls, the diameter of which he estimated at two feet, projected from the clouds down into the water. The distance of the point where he stood, from the point at which the balls struck the water, could not have been more than 150 to 200 yards. The phenomenon was witnessed in Sweden many years ago.

Mr. Wild exhibited the universal, or alphabet, telegraph of Professor Wheatstone, and pointed out the successive improvements which had resulted in this admirable invention.

CORRESPONDENCE.

Reflections on the Bursting of Steam Boilers.

To the Editor of the Chemical News.

Sir,—Your Correspondent "C. J. S.," in his "Reflections on the Bursting of Steam Boilers," distinguishes two distinct kinds of steam, "aqueous vapour" and "aëriform steam." As an example of these he mentions the blowing off of steam from the safety-valve of a high-pressure boiler; for three or four inches the vapour is invisible, beyond which it assumes an opaque appearance. I do not look upon these as different kinds of steam. The "invisible" vapour is actual steam, which, on escaping from the valve, retains sufficient heat to keep it in a state of vapour; the "opaque" steam is steam so far cooled by the atmosphere that minute globules of water are formed and give to the steam its opacity.

"C. J. S." goes on to say that when the atmosphere is very highly charged with the elements of water it never continues so long without change; the gases, he says, may unite, and the water formed descend as showers of rain.

But how can he assume that hydrogen exists in the atmosphere uncombined? and, even if such were the case, let him consider what an enormous quantity of oxygen and hydrogen it would require to form water enough to produce but a small shower of rain; besides which the noise from the union of the gases would be louder than any thunder man ever heard.

Enclosed, he says, in a steam boiler, the gases unite into the powerfully-elastic vapour of water.

How could the gases become separated in the boiler? Heat, indeed, often tends to disunite substances; but no heat produced in a boiler could separate from an atom of steam its oxygen and hydrogen, there being no substance present having attraction either for the one gas or the other.—I am, &c.

G. F. R.

Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—In the inductive sciences a philosopher reasons in two distinct ways, either synthetically or analytically. In a synthetic argument the truth of his proposition depends upon postulates that are facts; but, in analytical reasoning, one of his premised principles is hypothetical, remaining so until the conclusion of the demonstration, when it is either shown to be a truth or an "absurdum." Synthesis, where it can be applied, is always better than analysis; and proofs concerning facts are invariably more

intelligible and correct than those involving hypotheses. Euclid seldom, if ever, gives an analytical proof where synthesis will do; and we, in our studies in physics, frequently find ourselves quite positive of the truth of our deductions, when all the time we are only inferring what would take place under certain circumstances.

For these reasons, our hypothetical laws of nature must necessarily be often found fictitious, and in such cases the best way is candidly to confess their failure. The atomic hypothesis is one of these; it has stood its ground for a long while, but now we see it is no longer admissible.

The following is an answer to the letter of the 20th October, written by "Ultimatum":—

All congregations of small, definite solids are powders,
No fluids are powders,
Therefore no fluids are congregations of small, definite solids:
All atoms are small, definite solids,
Therefore, no fluids are congregations of atoms.

—I am, &c. THOMAS S. BARRETT.

Specimen Exchange Club.

To the Editor of the CHEMICAL NEWS.

SIR,—I think the plan mentioned in your periodical for forming a Chemical Exchange Club is excellent. I think it will be well to attach to specimens sent to be exchanged, if chemically prepared, the best method for preparing them, and, if minerals or natural products, some particulars concerning them, as, for instance, the places where they naturally grow, are found, or occur.

I sincerely hope that the plan may be carried out; if it is, it will really be very useful. I trust in an early Number you will let us know what further steps have been taken. I should think that the proposals I have made would be well received.—I am, &c.

J. C. S.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Quadroxalate of Iron.—Dr. T. L. Phipson[1] has investigated the composition and properties of the oxalate of the protoxide of iron. Oxalic acid forms with iron two distinct salts according as it combines with the proto or peroxide of the metal. The properties of the salt of the protoxide are as follows:—It is a pale yellow powder, unalterable by light or air, insoluble in water or excess of oxalic acid, cold or warm; very slowly soluble in cold hydrochloric acid, nitric acid dissolves it by transforming it into a soluble salt of the peroxide. When heated it takes fire at a comparatively low temperature and burns like tinder, leaving a residue of red oxide of iron. Ammonia decomposes it into ferrous oxide and oxalate of ammonia. With ferricyanide of potassium it acquires by partial decomposition a beautiful pale green colour, which might be employed in water or oil painting. This green powder likewise burns like tinder when heated. The salt is prepared by adding an excess of oxalic acid, or better of oxalate of ammonia, to a solution of ferrous sulphate. In either case the yellow precipitate only appears after strong agitation or after standing for several hours. The precipitate is anhydrous, and upon analysis yields results which closely agree with the formula $FeO.4C_2O_3$. The salt is, therefore, anhydrous quadroxalate of iron.

Oxides of Cerium.—These have been examined by Stapff.[2] He began with the double sulphate of the protoxide and potash. This salt dissolves very slowly in water, and it is necessary to acidulate the water to prevent the deposition of basic salts. The author's first object was to see whether salts of the protoxide of cerium would reduce chloride of gold, which experiment decided in the negative. It was the same with the protoxide of lanthanum. The protoxide of didymium gave a slight precipitate of gold, but that was probably due to some foreign cause. Protoxide of iron, then, may be estimated in the presence of the protoxides of cerium and lanthanum by the weight of gold reduced. The author's next object was to see whether the protoxide of cerium could be estimated by a standard solution of permanganate of potash, which was also decided in the negative. The permanganate is immediately decolorised by the double salt of cerium dissolved in water acidulated with hydrochloric acid; but after a little time chlorine is disengaged, owing to the action of the hydrochloric acid on the ceric salt—the perchloride of cerium immediately after its formation being again reduced to cerous chloride. When, therefore, more permanganate is added, this also is decolorised, and so it goes on until all the free hydrochloric acid is completely saturated. A current of chlorine the author found transformed a cerous into a ceric salt, which, on the addition of potash, undergoes partial reduction, the ceroso-cerous hydrate being precipitated. The hydrochloric solution of the last is transformed into cerous chloride by boiling with a plate of copper. This experiment, performed with proper precautions, may be applied to the estimation of cerium. Nitrate of cerium calcined in air left a binoxide, or perhaps the oxide C_3O_7. Calcined in hydrogen, the protoxide remained. In the course of his researches the author remarked that the protoxide of cerium is completely precipitated by caustic ammonia; the precipitate dissolves partially in ammoniacal salts, and completely in a saturated solution of oxalate of ammonia. The oxide of lanthanum, on the contrary, is but imperfectly precipitated by ammonia; a dilute solution of oxalate of ammonia is the best precipitant of lanthanum.

II. ANALYTICAL CHEMISTRY.

Assay of Olive Oil.—M. Cailletet[3] makes use of a solution of hyponitric acid for ascertaining the purity of olive oil. We are not told the strength of the acid solution employed. The manner of testing, when the temperature is between 10° and 14° Cent., is as follows:—4 cubic centimetres of the oil to be tested, and 3 cubic centimetres of the solution of hyponitric acid, are placed in a bottle which will hold 15 cubic centimetres. The bottle is closed with a cork, and shaken for five seconds. Both the oil and acid solution must be placed in a bath of cold water, before the experiment is made. When the temperature ranges between 15° and 25° Cent., the acid and oil must be set in a bath cooled to about 10° or 12°, before testing. The same quantities of acid solution and oil as before are placed in a bottle, which is then corked and set in the cold bath for a minute. It is then withdrawn and shaken for five seconds; again set in the cold bath for a minute, and again shaken for five seconds. It is placed once more in the cold bath for a minute, and then withdrawn and allowed to rest. If the olive oil is pure, it quickly assumes a verdigris colour, which it retains for fifteen or twenty minutes, when the temperature of the surrounding atmosphere is over 25° Cent.; when the olive oil is adulterated with another oil, the verdigris colour disappears in a little time.

Detection of Wool and Cotton in Silk Tissues.—Professor Steffanelli[4] employs a solution of caustic ammonia, to which enough hydrated oxide of copper has been added to give it a deep blue colour. He places about 2 centimetres of the tissue to be examined in a test-tube, adds 10 or 12 cubic centimetres of the solution, and stirs with a glass rod. If the tissue is entirely composed of silk, it is dissolved in about four or five minutes,

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[1] *Comptes-Rendus*, t. li. No. 17.
[2] *Journal für prakt. Chemie*, t. lxxix. s. 257.
[3] *Bulletin de la Société Industrielle*, t. xxix. p. 463.
[4] Dingler, *Polytechnisch. Journal*, Bd. clvi. s. 225.

unless the silk has been dyed black—in which case it may be ten or twelve minutes before complete solution is effected. After the solution has acted on the tissue for four or six minutes, it is diluted with water, decanted if any matter remains undissolved, and then treated with nitric acid until it loses its blue colour. If now the tissue contains cotton, there is formed *immediately* a mass of flocculi, white or slightly coloured, which are composed of cellulose more or less modified, or of cellulose mixed with colouring matter. If the tissue is composed of silk alone, or of silk and wool, the precipitate is only formed after some time. It is possible to prove the presence of cotton and wool by one experiment. By employing a large quantity of the reagent, the cotton dissolves, and may be precipitated by nitric acid, while the wool remains undissolved. The author sums up the advantages of his process as follows:—1. It is equally applicable to dyed or white stuffs. 2. It serves to detect cotton or wool in silk stuffs, even when present simultaneously, and also to detect cotton in woollen fabrics. 3. The experiment is made in a very short time.

II. ORGANIC CHEMISTRY.

Decomposition of Milk.—Fresh cow's milk exposed to the air absorbs oxygen, and disengages carbonic acid, the volume of carbonic acid disengaged being greater than that of the oxygen absorbed. This exchange of gas takes place very rapidly after twenty-four hours; and milk in contact with a volume of air greater than its own takes up all the oxygen in three or four days. In an atmosphere of pure oxygen, the absorption of this gas and the disengagement of carbonic acid takes place still more rapidly. The carbonic acid, says Hoppe,[1] is formed at the expense of the organic materials of the milk, which undergo a sort of combustion; and, as the volume of the resulting carbonic acid is greater than the volume of the oxygen absorbed, it is clear that some of the oxygen of the organic bodies must take part in the formation of the carbonic acid. The author thus arrives at the conclusion that at the same time the carbonic acid is disengaged, bodies must be formed richer in carbon and hydrogen than the normal ingredients of milk. To determine the nature of these bodies, the author took two portions of the same milk, added alcohol to one, and submitted it to analysis immediately, and analysed the other portion after having left it exposed to air for some days. The results of this and similar experiments repeated many times show: 1. That milk which has been exposed to the air leaves considerably less solid residue than fresh milk. 2. That after milk has been exposed to the air it shows richer in fatty matters than the same milk, having alcohol added to it and analysed immediately. It seems, therefore, that fatty matters are formed at the same time that carbonic acid is disengaged. The author thinks that casein is the subject of the changes.

Acid of Benzoin Resin.—Kolbe and Lautemann[2] have met with some specimens of gum benzoin which do not contain benzoic acid. From one sample of the best quality brought from Sumatra, they extracted an acid altogether different from benzoic, fusible in hot water, and giving oil of bitter almonds when oxidised by means of permanganate of potash. The authors think that this acid is identical with the alphatoluylic acid, which Möller and Strecker obtained by treating vulpinic acid with baryta.[3]

MISCELLANEOUS.

Royal Institution.—The general monthly meeting of this Institution will be held on Monday, November 5, at 2 o'clock p.m.

[1] *Chem. Centralblatt*, v. s. 49.
[2] *Ann. der Chem. und Pharm.* Bd. cxv. s. 113.
[3] Chemical News, vol. i. p. 311.

The Analyst for the City of London.—At the last Court of Common Council, it was announced that the Secretary of State for the Home Department had sanctioned the appointment of Dr. Letheby as analyst.

Six Persons Poisoned by Cheese.—Several cases of poisoning, happily not accompanied by fatal results, took place in Glasgow on Saturday night. On that evening information was received at the central police-office that several parties residing in Prince's Street and Saltmarket had been taken seriously ill, the supposition being that they had been poisoned. Dr. M'Gill and Dr. Chalmers, of Trongate, at once visited the individuals, and found that the information was but too correct. From the symptoms exhibited, the medical gentlemen conjectured that the sufferers had been arsenically poisoned, and they administered accordingly. After considerable exertion all the parties were placed beyond the reach of danger, and it is now hoped that they are on the fair way towards recovery. The cheese from which the portions had been taken was but newly cut, and it appeared to be a Dunlop of good quality. The one, as well as several others in the shop where it was purchased, of the same make, have been taken possession of by the police, and will be submitted to a chemical analysis.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

W. Pickard.—Your silvering solution was very good, but it would only deposit an exceedingly thin coat of metal on the brass, which in the process of cleaning would be rubbed off in a short time. A better plan is to mix prepared chalk and chloride of silver together, and then rub the brass or copper with the mixture, moistened with a little water. By this means the article will be cleaned and silvered at the same time. Such a thin coat of silver will be sure to tarnish soon. It must be kept from the air as much as possible.

W. Procter, jun.—Letter of the 11th ult. arrived, but no journals yet. The Chemical News shall be forwarded as requested. We shall be most happy to lay your Pharmaceutical novelties before our readers.

F. R. S.—An application to the Secretary, Dr. Odling, Burlington-house, Piccadilly, will obtain for you every information necessary for intending Fellows of the Chemical Society.

J. S. O.—We are sorry for you, but cannot interfere in the matter.

A. B. C.—Employ the method of detecting alumina in the presence of iron, given by Mr. Reynolds in our 45th number.

Errata in last number,—P. 230, col. 1, lines 5 and 6 from bottom, *for* "13° C. corresponding to 55° 4 F.," *read* "23° C. corresponding to 73° 4 F."—Also, lines 26 and 27 from bottom, *insert* 9 *in place of* 5, and 5 *in place of* 9.

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THE CHEMICAL NEWS.

VOL. II. No. 49.—November 10, 1860.

BUILDING-STONES AND PRESERVATIVE SOLUTIONS.

[SECOND ARTICLE.]

FROM what we have said of the composition of stones, it will be seen that those which are best suited for buildings in the Gothic, or any similar style of architecture, are, by the possession of that very quality, unfit for employment in the erection of edifices subject to the action of an atmosphere like that which envelopes London and other large cities, unless they can be protected from this action by the application of a substance of some kind. All men are agreed as to the necessity of this; the point on which they differ is the kind of substance to be employed. In the case of Buckingham Palace, paint was the means adopted to arrest further decay, but the objection to paint, apart from its unsightliness, is, that it is no sooner laid on than it begins to yield to influences similar to those it is used to guard against: the oil decomposes, and gradually separates from the lead, and the dirty-looking, blackened surface, slowly flakes off, and the whole process has to be gone over again in the course of a year or two. Moreover, the idea of going to the expense of raising a structure of stone, and then painting it, would be considerably more absurd than employing the same means with the view of improving the appearance of the lily. That the fronts of so many large houses in this city are painted, is owing to the use of stucco, which must of necessity be painted in order to give it a false appearance of being what it is not. To preserve stone effectually from the action of the air, and at the same time to allow it to retain its natural beauty, is the problem which chemists have to work out. How far the inventors of the different preservative solutions now in the market have attained this object, is a question which we conceive is not yet decided; at the same time, the fact that these processes are patented is an obstacle to others making researches in the same direction, inasmuch as the number of substances available for the purpose is so limited that it would be difficult to avoid what might be held to be an infringement of patent rights. The method of preserving stone by coating it with a siliceous solution, was known to, and employed by the ancients. Colonel Rawlinson says, that he saw, at Behistun, a stone surface, several hundred feet in extent, which was covered with engraved characters, made about 500 years B.C., which yet offered only partial signs of decay, from having been coated with a flint varnish having the appearance of somewhat opaque glass. The discovery of a preservative process of this kind is so simple, that there is no doubt it would have been made ages ago if our forefathers had seen the necessity of guarding against decay in the magnificent structures they raised; but it seems they must have possessed more skill, or exercised more care in the choice of their building materials than we are in the habit of doing, seeing that their edifices remain almost uninjured after the lapse of centuries, while ours begin crumbling to pieces before they are well finished.

With the discovery of the water-glass in recent times the name of M. Fuchs, of Munich, is associated; but his efforts to bring it into extensive use in England were almost ineffectual, though it probably gave the clue to the different modifications of the process now in use. Kuhlman, a French chemist, and others, took up the subject, and experiments were undertaken with the view of making the discovery available in protecting stone, wood, and even mortar used in sub-aqueous works, from decay. All the processes employed are based on the fact that common flint is soluble in a caustic alkaline solution, at a very high temperature, say of 300° Fahr., or thereabouts. This solution is as easily applied to a surface as though it were water; but when so applied, an exposure for a greater or less period,—but in no case a very long one,—renders it extremely hard. The new surface would be a hydrate of silica, and, as such, would be liable to the action of the alkaline carbonates contained in the atmosphere; but it is asserted by Kuhlman that when this solution is laid on stone there is a further decomposition, the result of which is to coat it with a silicate of lime, which is not susceptible of this action.

There is room for doubt whether this really does take place in Kuhlman's process; but, as regards Ransome's, there can be no doubt about it, inasmuch as it is obtained by applying two different solutions, the result of which is to produce silicate of lime by double decomposition. His method consists in applying the silicate of soda, prepared in the manner described above, to the stone, and then laying on a solution of chloride of calcium. The result is that silicate of lime is formed, which attaches itself to the stone as closely as silver does to a copper plate in electrotyping, and common salt, which is washed off. Theoretically, nothing could be more certain and perfect than this result; but the experiments tried with it at the Houses of Parliament seem to prove that in practice it is not altogether so free from defects as it ought to be. The reason of these partial failures, however, we ascribe rather to the conditions under which the experiments were made. At the lectures delivered at the Royal Institution, specimens of stone operated upon by this process were exhibited by Professor Ansted, which were all that could be desired.

Szerelmey's process is so far a secret that it has never been described by the inventor; but, from what has been ascertained, it seems that it differs from Kuhlman's only in the subsequent application of a bituminous solution, or, at any rate, in the addition of bitumen at some stage of the process. Whether this is merely to protect the stone from the atmosphere while the silicate of lime is in course of formation, or whether it enters into the composition of the preservative solution and becomes a constituent part of it, we are, as yet, unable to say. Flint itself, it is said, contains a small portion of bituminous matter, to which it owes its colour, and, there-

fore, there would be no difficulty in adding a little more, if such a course were found advisable. Whatever preservative process may ultimately be preferred, this is accepted as the best at present, but time alone can determine whether it really is so or not. In the letter written by "An Architect," it is stated that the composition applied by M. Szerelmey to the walls of one of the courts at Westminster during the summer is still soft, and can be scratched off with the nail; but we do not think that this is of much importance, unless it be shown that in consequence of this softness the surface beneath continues to decay.

The reason of the partial failure in those cases where the solution has been applied, arises, we conceive, from the condition of the stone at the moment of its application. The surface was frequently rotten; and, where that was not the case, there was, in all probability, so great a quantity of moisture present in the stone that the chemical action was checked, or altogether prevented. It has been suggested that there was another cause of its flaking off, arising from what has been termed "nitrification"—in other words, the formation of crystals of nitrates, which is frequently observed in stone surfaces, and on the plaster which coats the walls of damp rooms. Whatever may have been the cause, there is no denying the fact that the attempts to cover the stones of the Houses of Parliament with a siliceous varnish, as Colonel Rawlinson terms it, have been almost ineffectual, chiefly, we believe, from the conditions under which it was applied, and the remedy for which we propose to develope.

It will be seen that the difference, if difference there be, between the processes described is so very trifling that the results in either case would be pretty nearly equal. The objection to Kuhlman's, that, in consequence of the slowness of the decomposition of the ingredients of which it consists, it is unfit for use in a climate so changeable as ours, where a shower of rain would probably intervene before the process was completed, and wash off the solution, is as applicable in a minor degree to all the others. But we submit that there is not the slightest necessity for incurring this risk in future. Instead of applying the solution to the building, let it be applied to the stones while in the stonemason's yard. This is a point which we have not seen mentioned in anything we have read on the subject. We cannot conceive what difficulty there could be in cutting the stones and then leaving them under shelter, but exposed to a current of air to evaporate the moisture out of them. In this way they would become dry, and, as they dried, they would harden. The pores of the stone being thus freed from moisture, they would absorb the preservative solution into them just as a sponge sucks up water, by capillary attraction; so that it would not be merely a surface protection, which might be gradually destroyed by the mechanical action of the rain driven against it by a high wind, but a solid mass of material, alike unassailable by the chemical action of gases in the atmosphere, or by the mechanical attrition of the particles of dust and rain. This need involve no additional cost for materials, and its adoption would not only obviate the objection to the employment of soft stones, but, as we believe, actually render them preferable, as being even more imperishable than the finest marble; and in the case of magnesian limestone imperfectly crystallised, which, under ordinary circumstances, crumbles to powder, would entirely prevent this decay from being of material consequence by indurating the stone to so considerable a depth.

There is another method of applying the solution which might be even more effectual, but in the case of a large building it would greatly increase the cost, though, if it is a question between raising a building which will endure and one which will require to be renewed piecemeal, the greater outlay in the first instance will be the most economical. Suppose we are using Bath-stone: this can be sawn up when freshly quarried in blocks of any convenient size almost as easily as if it were wood. These blocks may then be placed in an air-tight vessel, and the air exhausted until the stone became desiccated; the solution being then admitted, would be forced into the pores of the stone so thoroughly that there would be no danger of ultimate decay.

We see no reason to doubt that the employment of either of the above methods of applying the preservative solution would have the effect of rendering the stone to which it is applied impervious to all injurious influences; if it be not so, then all future controversies as to the suitability of a modification of the Gothic style of architecture for our public buildings will be vain and ridiculous, and the only course open to us as a nation gifted with common-sense, will be to adopt a style in which we may employ the very hardest material at the smallest possible expenditure for mere ornamentation. Hitherto it appears to have been the custom to select the design for the building in the first instance, and to make the choice of material a secondary consideration; in future, unless a perfect preservative solution is employed, it will probably be thought advisable to reverse this order of proceeding.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Migrations of Phosphorus in Vegetables, by M. B. Corenwinder.

(*Concluded from page* 231.)

The vegetable matter which plants throw off from their exteriors, and which are looked upon as excretions, give ashes free from phosphoric acid. At least, I have proved this in the case of manna and gum-arabic.[1] If we admit, with the generality of physiologists, that these matters are excreted by the descending sap, an important conclusion may be drawn from this observation.

The sap, according to M. Langlois, contains a remarkable proportion of alkaline or earthy phosphates. In the elaboration of this nourishing fluid, the phosphorus is completely assimilated by the plant, which rejects all matters destitute of nutritious principles and useless for its development.[2] It is known that in

[1] According to some authors, there is found in gum traces of nitrogen and phosphates. I am convinced that that is not the case when operating upon specimens which are quite transparent and free from impurities.

[2] In 1853, in a Memoir on Silk-worms, M. Eugene Peligot has already expressed an analogous opinion. After having explained the composition of the ashes from silk-worms' eggs, which contain a great deal of phosphoric acid (53·8 per cent.), he proceeds to say: "This composition is interesting to all. It shows once more the important part that phosphoric acid plays in the formation of bodies; it gives to magnesia a more important function than that which is usually attributed to it. In comparing it with the ashes left by the worms taken at various ages, it is seen that the work which is accomplished by the insect is a work of incessant elimination, which has for its object to disperse gradually, under the form of excretions of a very varied nature, excretions of which the silk itself is perhaps part, the substances which first served for its development, and to concentrate at the end of its existence, such of the substances as are necessary to reproduce its species. These elements, which may be called '*organica-*

pounding the pulp of carrots or beet-root, and exhausting it with cold water until it is quite clear, the cellular and fibrous tissue is obtained combined with the outer covering. By burning the fibre in this state a great deal of lime and silica is found in the ash, but not much phosphate. The same results are obtained by pounding and washing the stalks and leaves of the purslain, the beet-root, &c.

If we, then, look upon this cellular and fibrous tissue as constituting the skeleton of the plant, it is strange that no phosphates are found after merely washing it with cold water. If the conclusion were not hazardous, it might be said that the bones of animals and those of plants, notwithstanding the essential differences which distinguish them, present still this similarity, that the first owe their solidity to earthy phosphates and the latter to silica and lime. Whichever way it is, the phosphates are certainly contained in the juices, and not the bodies, of plants. In removing the nitrogenous matter from plants, the phosphates are also removed, which, I repeat, have an existence independent of the organs,[3] and circulate in vegetables to produce phenomena of a higher order.[4]

If, with some chemists, we divide the organic elements of vegetation into two principles, the pectic and the proteïc,—the first destitute of nitrogen, the second eminently nitrogenous,—our former experience shows that they are characterised besides by this essential distinction, that the last contains a large proportion of phosphorus, and that the first is entirely without it. A good deal of phosphoric acid is generally found in the ashes of marine plants,—the algæ, the fucus, &c. M. Godechens has made a complete analysis of the ashes of different varieties of seaweed from the banks of the Clyde, and has found the phosphoric acid varies in proportion from 1 to 4 per cent.

I have also proved the presence of this acid in the ashes of Iceland moss, and also in that of a certain quantity of seaweed gathered upon the jetty at Dunkirk, in such a situation that the plant could not draw the phosphates from the earth. It is clear that these vegetables find the phosphates which they contain in the sea water; and yet in all the known analyses of water taken from different oceans no mention is made of even a trace of phosphate, alkaline or earthy.

I have not been able to discover phosphoric acid in a large quantity of salt water taken from the North Sea, a league from Dunkirk. I have even made researches upon the incrustations from the boilers of steamboats navigating the British Channel and in the ocean, and I am certain they did not contain a trace. We must then admit that phosphates are disseminated in the sea in such small proportions that they escape all our means of investigation and show the frailty of chemical analysis.

In a stream of water it is equally difficult to show the presence of phosphates, yet a small trace has been found in the Garonne. In the incrustations in boilers fed with river water, I have also looked in vain.

If I dared put forward an hypothesis with regard to this, I should say that phosphates ought to exist in the sea in combination with transparent gelatinous, animal matter, which proceeds from destroyed organisms, and which may be seen, of an unctuous appearance, in the scum of the waves when washed on the shore. If a large quantity of this organic *débris* was condensed there is no doubt that phosphoric acid would be found. In the sea, and also in rivers and streams, myriads of this organic *débris* exists, of various natures. By their tenuity, their weak consistency, they escape analysis; but the quantity is sufficient, without doubt, to nourish the vegetation of the rivers and that which floats on the ocean.

The large proportion of phosphates which are found in the ashes of seeds has induced me to look for it in the pollen dust of flowers. A first trial upon the pollen granules of the white lily taught me a fact which I consider of interest: it is, that these small organs contain a large proportion of phosphoric acid, larger even than that found in a grain of corn. The pollen of the lily gives a black ash, difficult to obtain, like that of cereals; it is very alkaline, and contains but little lime, magnesia, chlorine, and silica; it is formed, so to speak, entirely of alkaline phosphates. I have found in 100 parts of pollen, in a normal condition,

Phosphoric acid . . 1·45 per cent.

It must be remembered that Vauquelin has shown that the semen of animals contains also a large proportion of phosphorus. This similarity between two bodies which exercise the same functions in the two kingdoms is worthy of attention; and, what gives still more interest to the remark is, that the semen gives equally a black ash, alkaline, but containing very little lime, magnesia, or silica, &c. The proportion of lime is, however, larger than in the pollen of flowers. The ashes of the spores of the Lycopodium (*Lycopodium clavatum*) also contain phosphoric acid in considerable quantity. In 5 grammes of the substance, perfectly pure, and in the normal state, I have obtained

Phosphoric acid . . 0·92 per cent.

The ash of these spores has, in other respects, the same appearance as that of pollen; and, like the latter, they are characterised by an absence of lime, silica, and magnesia.

The presence of so large a quantity of phosphorus in these fluids, and these mysterious organs intermediate between the life which is about to cease and that which is about to commence, affords material for much reflection. One cannot repress a feeling of profound admiration upon seeing this body, gifted with such energetic properties, assist in all those functions whereby the being is perpetuated or existence transmitted.

The preceding observations must only be looked upon as the first of a series of observations which I have undertaken on the position occupied by phosphorus in the phenomena of life, and its different migrations in the Vegetal Kingdom. I propose to continue these researches in investigating the organs at different epochs of their development, in our river and sea plants.

As I said before, this method of observing Nature by confining onesself to the study of one single order of facts is very fruitful. This I have found from experience. When the mind is preoccupied with too many subjects at a time, it seizes analogies with difficulty; it is absorbed by the details; the truth being obscured by a cloud of phenomena is only seen with indistinctness. It is by the division of labour that, in science as in all other manifestations of human activity, we arrive at discoveries and results which escape the man who is eager to embrace all sides of the horizon at once.

teurs' par excellence, are the same which are met with in all seeds, in eggs, and in fat: they contribute to the formation of all that is born and of all that is developed."

[3] Some time ago, M. Payen proved that the nitrogenous substances of plants have a separate existence from the tissue. This eminent Chemist has succeeded in dissolving the animal matter by alkalies, without producing the least rent in the organs.

[4] The dry leaves which remain in the forest during the winter, give an ash, rich in iron, silica, and lime, but destitute of phosphoric acid.

TECHNICAL CHEMISTRY.

On the Chemical Constitution of Cast Iron and Steel, by M. E. Fremy.

The interesting communication of Captain Caron[1] has furnished me with the occasion to make known to the Academy some of the results obtained in a research—which I have long pursued—into the constitution of cast iron and steel. The facts here stated have been already communicated to several Members of the Academy, and I have likewise alluded to them in my lectures at the Polytechnic School.

Numerous observations prove that nitrogen exercises an influence over the phenomenon of steeling, and confirms the opinion which our learned colleague, Mr. Despretz, has recorded in his work on Nitride of Iron.

Indeed, all chemists are aware of the rapid transformation of iron into steel under the influence of ferrocyanide of potassium, and the interesting researches of M. Sanderson, in which this skilful manufacturer proves that in the cementation boxes steel is formed only under the double influence of carbon and nitrogen. I considered that in the process of cementation the nitrogen not only presented the carbon in a gaseous state to the iron, but that, remaining united to the carbon, it could itself combine with the metal.

The presence of nitrogen in certain specimens of iron, cast iron, and steel, has been already recorded in the most precise manner by M. Marchand. It remained to discover under what state nitrogen could exist in steel or cast iron. This is the question I desire to examine.

In following the method of Berzelius, when steel or cast iron is submitted to the action of bichloride of copper, a residue containing graphite and a brown matter is obtained. This last substance is not carbon, as is generally believed; it is partly soluble in potash. When heated it disengages a considerable quantity of ammonia, and shows an analogy with certain derivatives of cyanogen. Experiments (which I shall make known in a special Memoir) tend to prove that cast iron and steel, hitherto considered as carbides of iron, are rather combinations of metal with a compound radical, comparable to cyanogen, and which, like it, is produced directly by combination of carbon with atmospheric nitrogen. The brown matter before alluded to, and the empyreumatic oil formed during the action of acids on cast iron and steel will be the products of the decomposition of this compound radical.

The metalloids, such as sulphur, phosphorus and arsenic, which modify so remarkably the properties of steel and cast iron, act, in my opinion, principally on the nitrogen compound of which I have just spoken, and can even modify it by substitution. On this point I shall adduce an experiment which appears to me interesting in a theoretical point of view, and which explains some facts observed in practice.

A specimen of cast iron, rich in graphite, prepared with wood charcoal, was melted in the middle of a siliceous slag. The ingot thus obtained was covered with graphite, and the casting, charged during the operation with three per cent. of silicium, remained grey and malleable. It consequently resembled the grey cast iron prepared with coke under favourable conditions. Silicium was substituted in this case for carbon, which crystallizing to the state of graphite in the metallic mass, formed the grey siliceous cast iron so well known to metallurgists. The same grey cast iron was then submitted to the action of various slags, so as to impart sulphur, phosphorus, or arsenic to the metal. In these trials the cast iron became white, and the metalloids were substituted for the carbon, which being completely eliminated from the metallic bath, crystallized on the surface into large plates of graphite. These specimens of cast iron treated by acids produced the empyreumatic oils which contained the metalloids employed to whiten the cast iron.

When sulphur is introduced into cast iron it expels a part of the carbon, and forms a sulphuretted radical, producing a white cast iron no longer possessing the property of incorporating itself with graphite, like the ordinary grey cast iron.

By studying the modifications produced by metalloids on the organic substance contained in cast iron, fine metal, and steel, the relation between these products is determined. For this purpose the existing chemical analyses are inadequate; indeed, the analytical notions bearing upon the crude determination of carbon contained in cast iron and steel, furnish no useful indication, for in general the name of carbon is given to a mixture of graphite and an organic nitrogenous substance; account is also taken of the graphite, which is simply interposed in the metallic mass, and plays no part whatever, while the determination of the nitrogenous substance, which appears to be the really active body, is neglected.

Upon the whole, it appears to me, at the present time, impossible to admit that cast iron, fine metal, and steel are formed essentially by the combination of iron with carbon, and that the difference between them is due simply to the proportion of this metalloid present. The substance which in the preceding compounds modifies the properties of iron so usefully for the arts, may be sometimes a metalloid, and also, sometimes, a compound; it is then allied to the derivatives of cyanogen, and, like them, is transformed by the action of metalloids; when this substance contains either nitrogen, sulphur, phosphorus, or arsenic, it forms, when united with iron, cast iron, either white or grey and spotted, fine metal, and steel.

The colour and appearance of the castings are not sufficient, then, to determine their composition; there are several kinds of white castings which differ from one another, according to the nature of the metalloid they contain; a grey casting, prepared with coke holding two or three per cent. of silicium, may resemble another grey specimen prepared with wood, which is scarcely siliceous. The relations which connect cast iron and steel are not so simple as is generally believed.

At a period when it is required to produce steel at a low price, and various methods are in operation for converting cast iron into steel, it appears to me that the preceding facts may guide iron-masters in their experiments, especially in determining the nature of the problem to be solved.—*Comptes-Rendus.*

[1] Chemical News, Vol. II. p. 243.

On the Preservation of Platinum Crucibles.

In connection with some sensible remarks upon the use of sand in cleaning platinum crucibles,—a practice which, with Berzelius ("Lehrbuch der Chemie," 1841, 4th Aufl., p. 516), he heartily commends, urging that it should be employed every time that a crucible is used,—Erdmann explains the cause of the grey coating which

forms upon platinum crucibles whenever they are ignited in the flame of Bunsen's gas-burner.

This coating has given rise to much annoyance and solicitude among chemists. Indeed, it has often been asserted that the use of Bunsen's burner is unadvisable in quantitative analysis, since by means of it the weight of platinum crucibles is altered and the crucibles themselves injured. The coating is produced most rapidly when the crucible is placed in the inner cone of the flame, and the more readily in proportion as the pressure under which the gas is burned is higher. Having found it advantageous to maintain, by means of a special small gas-holder, a pressure of four or five inches upon the gas used in his own laboratory, Erdmann has observed that the strong gas flame thus afforded immediately occasions the formation of a dull ring upon the polished metal placed in the inner flame, this ring being especially conspicuous when the crucible becomes red-hot; it increases continually, so that after long-continued ignition the whole of the bottom of the crucible will be found to be grey and with its lustre dimmed.

This ring is caused neither by sulphur, as some have believed, nor by a coating of inorganic matter, but is simply a superficial loosening of the texture of the platinum in consequence of the strong heat; whence it first of all appears in the hottest part of the flame.

In conjunction with Pettenkofer, Erdmann instituted several experiments which have left but little doubt that the phenomenon depends upon a molecular alteration of the surface of the metal. If a weighed polished crucible be ignited for a long time over Bunsen's lamp, the position of the crucible being changed from time to time in order that the greatest possible portion of its surface shall be covered with the grey coating, and its weight be then determined anew, it will be found that this has not increased. The coating cannot be removed either by melting with bisulphate of potash or with carbonate of soda. It disappears, however, when the metal is polished with sand; the loss of weight which the crucible undergoes being exceedingly insignificant, a crucible weighing 25 grammes having lost hardly half a milligramme. When the grey coating of the crucible is examined under the microscope it may be clearly seen that the metal has acquired a rough, almost warty surface, which disappears when it is polished with sand. Platinum wires which are frequently ignited in the gas flame,—for example, the triangles which are used to support crucibles,—become, as is known, grey and brittle. Under the microscope they exhibit a multitude of fine longitudinal cracks, which as the original superficial alteration penetrates deeper, become more open, or as it were spongy, until, finally, the wire breaks.

If such wire is strongly and perseveringly rubbed with sand the cracks disappear, and the wire becomes smooth and polished; for the grains of sand, acting like burnishers, restore the original tenacity of the metal, very little of its substance being rubbed off meanwhile. The loosening effect of a strong heat upon metals is beautifully exhibited when silver is ignited in the gas flame; a thick polished sheet of silver immediately becoming dull white when thus heated. Under the microscope the metal appears swollen and warty. Where it has been exposed to the action of the inner flame along its circumference, this warty condition is visible to the naked eye. A stroke with the burnishing-stone, however, presses down the loosened particles and reproduces the original polish. This peculiar condition which the surface of silver assumes when it is ignited is well known to silversmiths; it cannot be replaced by any etching with acids; and it must be remembered that what is dull white in silver appears grey in platinum.

If each commencement of this loosening is again destroyed, the crucibles will be preserved unaltered, otherwise they must gradually become brittle. Crucibles of the alloy of platinum and iridium are altered like those of platinum when they are ignited. It is, however, somewhat more difficult to reproduce the original polish of the metal by means of sand, as might be expected from the greater hardness of the alloy.

The sand used should be well worn. When examined under the microscope no grain of it should exhibit sharp edges or corners; all the angles should be obtuse.—*Journ. fur praktische Chemie*, lxxix. 117.

On a New "Fusible Metal,"[1] *by Dr.* B. Wood.

Dr. B. Wood, of Nashville, Tennessee, has secured a patent (*Weekly Scientific Artizan*, Cincinnati, May 5th, 1860,) for an alloy composed of cadmium, tin, lead and bismuth, which fuses at a temperature between 150° and 160° F. The constituents of this fusible metal may be varied according to the other desired qualities of the alloy—viz. cadmium, one to two parts; bismuth, seven to eight parts; tin, two parts; lead, four parts. It is recommended as being especially adapted for all light castings requiring a more fusible material than Rose's or Newton's "fusible metal," it having the advantage of fusing at more than 40° F. lower temperature than these alloys, and, owing to this property, may replace many castings heretofore made only with amalgams. Its fusing point may be lowered to any extent by the addition of mercury, which may be employed within certain limits without materially impairing the tenacity of the metal. In a letter to the Editors of the *American Journal of Science*, dated Nashville, June 9th, 1860, Dr. Wood says:—

"One point in particular that strikes me as being worthy of note is the remarkable degree in which cadmium possesses the property of promoting fusibility in these combinations. The alloy of one to two parts cadmium, two parts lead, and four parts tin is considerably more fusible than an alloy of one or two parts bismuth, two parts lead and four parts tin; and when the lead and tin are in larger proportion the effect is still more marked. It takes less cadmium to reduce the melting point a certain number of degrees than it requires of bismuth; besides that the former does not impair the tenacity and malleability of the alloy, but increases its hardness and general strength.

"Bismuth has always held a pre-eminent rank among metals as a fluidifying agent in alloys. Its remarkable property of 'promoting fusibility' is specially noted in all our works on chemistry; but I do not find it intimated in any that cadmium ever manifests a similar property. The fact, indeed, appears to have been wholly overlooked—owing, perhaps, to the circumstance that as an alloy with certain metals cadmium does not promote fusibility.

"Cadmium promotes the fusibility of some metals, as copper, tin, lead, bismuth: while it does not promote the fusibility of others, as silver, antimony, mercury, &c. (*i.e.* does not lower the melting point beyond the mean.) Its alloy with lead and tin in any proportion, and with silver and mercury, within a certain limit, say equal parts,—and especially of two parts silver and one of cadmium, or two parts cadmium and one mercury—are used, are tenacious and malleable; while its alloys with some malleable metals (gold, copper, platinum, &c.), and probably with all brittle metals, are 'brittle.'

[1] *American Journal of Science*, vol. xxx. No. 85.

"I notice a great discrepancy among authors as to the melting point of this metal. It is usually put down the same as that of tin, 442° F. Brande ('Dict. of Science and Arts') says it 'fuses and volatilizes at a temperature a little below that at which tin melts.' Daniell, (according to the 'New American Cyclopædia,') gives its melting point at 360° F., while Overman places it at 550°, and gives 600° as the temperature at which it volatilizes.

"The latter is doubtless the nearest the truth. The metal requires for its fusion a temperature too high for measurement by the mercurial thermometer; but from relative tests with other metals I should place its melting point in round numbers at 600° F., as it melts and congeals nearly synchronously with lead, the melting point of which is stated by different authorities as 594°, 600°, and 612°. It volatilizes at a somewhat higher heat.

"I draw attention to these facts, believing that the metal possesses properties valuable to Art and interesting to Science, and that it merits more thorough investigation than appears to have been bestowed upon it."

PHARMACY, TOXICOLOGY, &c.

Red Precipitate Ointment, by F. A. Kefter.

Being aware of the great difficulty in keeping, especially in warm weather, the Ung. hydrargyri oxidi rubri, I have been led to make some experiments with the same, and find that, instead of using lard, if I use oleum ricini, that the preparation will keep perfectly well for a great length of time. I have now in my possession a sample that has been made over two years, and it is perfectly free from rancidity, and still retains its original colour, the mercury to all appearance not having become deoxydised in the least. My formula is

℞. Oleum ricini	. . .	ʒiiiss.
Ceræ albæ	. . .	ʒss.
Hydr. oxidi rubri	. .	ʒss.

Melt the wax and oil with a gentle heat, and when cool, rub in the red precipitate previously reduced to fine powder.—*American Journal of Pharmacy.*

Hypophosphite of Quinia, by J. Lawrence Smith, *M.D., Prof. of Chemistry, University of Louisville.*

I brought this article to public notice a short time ago. As I was not then prepared to give a statement of its composition, that omission will now be made up.

In 100 parts there is:—

Quinine	83·00
Hypophosphorous acid . .	10·09
Water of combination . .	2·30
Water of crystallisation .	4·60

Giving the formula $C_{40}H_{24}N_2O_4,PO,HO + 2$ aq.; or, according to Gerhardt's method of statement, just double that formula. Its physical characters have been fully described.

The manner in which it is manufactured at the Louisville Chemical Works is as follows:—50 ounces of sulphate of quinine are placed in a large porcelain capsule; to this is added 2 gallons of distilled water, and 2 ounces of hypophosphorous acid. Warm up to about 200° F., and make a perfect magma of the sulphate of quinine and water, then add a solution of hypophosphite of baryta, until a perfect decomposition is produced. Great care must be taken to have no excess of baryta salt; better have a slight excess of sulphate of quinine. But a little skill will enable a competent operator to obtain an exact neutralisation. While warm, the solution of hypophosphite of quinine is filtered off from the sulphate of baryta and allowed to crystallise. The sulphate of baryta is then washed, and the washings added to the mother water of the first crystallisation, and evaporated with great care, when other crystals may be obtained. If not carefully evaporated it will become coloured. The crystals are drained and dried on a cloth stretcher.—*Ibid.*

Tannin an Antidote to Strychnia.

Dr. Kurzak, in the *Zeitschrift der Gesellschaft der Aerzte zu Wien*, has published a paper in which he proclaims tannin to be a most excellent antidote in strychnia poisoning. The tannate of strychnia formed, is insoluble in the intestinal juices. For 1 part of strychnia, 20 to 25 parts of tannin should be given, or even more, because a considerable part of the tannin is precipitated by the contents of the stomach—gelatine, for example. When tannic acid cannot be obtained, strong infusions of powdered gall-nuts, or green tea, should be used.

[Tannin would probably be found to be the best chemical antidote for most of the poisonous alkaloids. —Ed. C. N.]

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some Recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A., F.R.S.*

Lecture VIII. *On the Antiquity of the Human Race.*

I suppose if there is one department of Geology more particularly interesting than any other, it is that which relates to the border-land between the present and the past—the passage from that which is to that which was; the connexion, if such exists, of the races of to-day with those of yesterday, and the means available for tracing the resemblances and the differences between what has been called the Ancient World, and our own modern and personal experience.

The human race was at one period, and that no distant one, regarded as coeval with the first introduction of life on a very recently-created world. Step by step the careful and unprejudiced observers of the great truths of nature have become convinced that man not only was not coeval, or nearly coeval, with life on the earth, but that the world is of extremely ancient date—that numerous tribes of animals and vegetables had preceded man by long intervals—many large groups and entire races having succeeded each other, the earlier ones dying out very long before he appeared. If anything can be said to be known in geology, or proved by incontestible evidence, it is that our forefathers, whenever they came upon the stage, and however they were first introduced, formed an addition to groups of animals which then peopled the various lands. They entered on an inheritance prepared for them, and have since continued to cultivate and rule over it. It becomes a question to be determined by natural history evidence, in which part of the great series of organised beings did they first appear?—who were their early associates?—what geological events have occurred since their introduction?—and at what point in the general geological sequence are we to write: Here are the first indications of the existence of intelligent beings; at this stage of animal life the human intellect first dawned?

I trust it is altogether needless that I should apologise for introducing to you in this place a question of science

so legitimate. The question is one in which the evidence must be calmly and carefully weighed, and the conclusion accepted to which the balance of evidence points. On the one side there is a written document of the highest authority for the purposes and in the matters it was intended to teach; but notoriously, and by almost universal consent, not binding upon us in respect to matters of experimental science and observation, these requiring only the fair and honest exercise of human reason for their elucidation. On the other side is the great volume of Nature, written by a sure hand, engraved in tablets of stone, which, if broken, are not defaced, and which are capable of interpretation, if we will only exercise patience and care. These two sources of truth cannot really be at issue, although we may be unable to see how they agree. We must not close our eyes to the truth, from whichever source it is obtained; and in the question we now enter upon—the Antiquity of the Human Race—whatever facts can be discovered bearing on the subject, must be accepted, and we are bound also to accept the fair inferences to be drawn from them.

Assuming, then, that the evidence of human antiquity is to be derived chiefly from the discovery of human remains, in various deposits and this being almost the only means open to us when we endeavour to extend our researches beyond written history, we are bound to accept it as given by Nature, examining it carefully, and getting the results as we best can, admitting that we must look to geology to determine this great archæological problem. Now, it seems to me that the points to be made out in this matter of the antiquity of the human race, are of this kind:—We must first obtain a starting-point — some object buried beneath deposits, or associated with other contemporaneous things elsewhere so buried; we must make sure that time was required for forming such deposits as overlie it, and, indeed, that the deposits we find over it are of such a nature as to require a considerable lapse of time in order to produce them. The way in which the evidence will then come out I will explain to you. But first, the mere fact of finding deposits overlying the discovered object and each other, will not alone amount to much; we must show that they were formed in such a way as to require time. Take, for instance, a broken flint. One side of such a flint may have been recently broken, and the other side worn in a manner which must be a result of exposure for a very long time to the action of the weather. When, therefore, we find a specimen with appearances of this exposure, we are at liberty to assume that time was required in order to produce it.

We have also to prove that any remains that we may find in rocks of this age really were produced by human agency. We must carefully examine the evidence on that head.

We must next prove that they were really found in those beds that we have already proved by independent evidence to be of very great antiquity.

We must also satisfy ourselves that, if found as supposed, the objects in question were not placed there for the purpose of our finding them, or by any accident, whose result would be to make us imagine that what was really produced at one time belongs to another. Before the Romans conquered Britain there certainly were people who lived in these islands in an extremely rough and savage state, sometimes even in houses dug out of the earth. These people may have dug pits and lived in those pits; and it is possible to imagine that specimens we now obtain from what seem to be gravel-beds, were really dug out of such habitations. We must satisfy ourselves, therefore, that the broken flints were deposited contemporaneously with the beds in which they occur, and were not subsequently inserted.

Now, in order to obtain the starting-point that we require, we must limit ourselves to geological events of a very recent date. The more recent of the various deposits accumulated during a long succession of ages at the bottom of seas which once covered what is now Western Europe, were either themselves small or in patches, or have since been extensively removed by the action of water. Among them are mixed heaps of fine sand, and large angular or rounded blocks of stone, resting indifferently on all the underlying rocks. These so-called blocks, or boulders, include a variety of fragments of rock, some removed for hundreds of miles, and others only from the near neighbourhood. With them are stones of various sizes, often placed among the sands in such a way as to render it impossible that all can have been beaten and rolled together for a long time in water, The stones are not unfrequently furrowed and scratched, and the rocks beneath, if hard, are similarly marked. This is the deposit called by geologists *boulder clay*, and believed by them to have been produced at a time when large icebergs floated or drifted over the land where such materials are now deposited. These are, therefore, remains of an icy or glacial period, or periods, during which most of the present land of Western Europe was under water; when icebergs came down from the Arctic Circle to our latitudes; and when the land that did exist was for the most part in a different position from that which now exists. These beds are the old glacial drift of Northern Europe. They belong to a climate probably much warmer than any we now have north of the Mediterranean (except, perhaps, that of the South of Spain); and, during this earlier period, the land of Southern Europe was peopled by animals resembling those now inhabiting Northern Africa, and ranging through the whole of that great continent. The shells of the adjacent seas were also those of the warmer parts of the Mediterranean. Most of the quadrupeds, and many of the shells before the time of the boulder clay, or old glacial period, are different from those of the more recent period. I propose, for the sake of convenience, to take this old glacial drift, or boulder clay, as the starting-point for my present purpose. In itself it generally contains few fossils. A great deal of the material lying over it, or at least deposited more recently, is what is called gravel or drift, and includes the objects of the present inquiry. Some of this is ancient, some more modern; some is of fresh-water origin, and some has certainly been formed in the sea. Some beds contain delicate shells, and have been deposited in calm water; some appear as if they had fallen down in a turbulent ocean. Wherever occurring, gravel is a deposit amongst the newest of those talked of by geologists. It is hardly even admitted to rank among the newer of the three great groups of deposits called *Tertiary*. It belongs to what Continental geologists call *Quaternary Rocks*. It is widely dispersed, but rarely in large deposits.

It is important for my purpose that you should recognise the antiquity of the boulder clay or old glacial drift, our starting-point. Relatively, or compared with underlying deposits, it is modern; compared with it even the beds of crag beneath it are exceedingly ancient. The chalk below the crag belongs altogether to another world, and yet the chalk is but a thing of yesterday compared with large series of stratified rocks common throughout Europe. The London clay, which is very much more modern than the chalk, belongs to a time when there scarcely existed a species of animal, and very few plants, identical with those now inhabiting our country. In the yet older rocks—those below the chalk—we lose nearly all record of existing creation. Under the boulder clay, then, there is a long series of deposits, of which the most recent is of much earlier date, and during which the climate was exceedingly warm in this part of the world. After that there appears to have been a series of considerable elevations in Northern Europe, producing a great amount of cold over almost all the land then above the water. This

was followed by a remarkable period of northern depression, during which icebergs disappeared, and the climate became again warm. Afterwards there was another elevation in the north, and another period of glacial drift took place; and finally, there were depressions of very considerable extent, allowing the upper beds of the drift to be deposited.

These facts are proved in various ways, and I shall explain to you presently in what way the evidence is obtained. At any rate, I must suppose you to admit that the boulder-clay period is of great antiquity, and preceded the last great changes of climate, during which many of the animals appear to have changed. There was a time when elephants, hippopotamuses, and other animals now belonging to warm latitudes, ranged so far north as actually to have been caught up by the ice in the Arctic Circle. There are instances where even the flesh and the contents of the stomach have been preserved. When these animals ranged over the whole of the land in Northern Europe, the temperature must have been exceedingly different to what it is now; for at present there is no food within many hundreds of miles of their ancient haunts, whilst of the animals themselves the woolly hair covering a thick hide was evidently adapted to cold climates, and marks the climatal condition of the period which preceded the boulder clay. Assuming, then, that the boulder formation itself is of great antiquity, we must now consider the state of the different beds that lie over it. It is here that we find those curious remains which are believed to have been formed by human agency, and we must therefore understand clearly what were the beds thus characterised. [The Lecturer then directed attention to a section representing the condition of the country between Norwich and the sea.] Along the coast of Norfolk, and in the interior of the county for some distance, the boulder clay is met with on and near the shore, but seen only occasionally, and at low water is a submerged forest, the remains of a considerable quantity of tree vegetation, which has been entirely buried long enough to allow all the other deposits to accumulate over it. The boulder clay lies over it, and over this clay is the upper drift. The history of the submerged forest is curious, because the state of things to which it points exactly corresponds, as far as can be made out, with what is known in other parts of Europe, where also there is evidence of a much warmer period having preceded the boulder-clay period than characterised that period itself. The deposits overlying the clay here and elsewhere may be considered to form three distinct groups. There is, first, the group of cavern deposits, then the raised beach deposits, and then the group of superficial gravels and sands, and I must say a word or two with regard to each of them.

By caverns I understand natural open spaces in rocks occurring in various parts of the earth, often partially filled by deposits of various kinds drifted into them. When such an opening has been exposed to the action of a river or the tidal action of the sea, or is open above so that animals can get into it, there will be drift carried in and deposited, while, at the same time, remains of animals will accumulate in it, and there will be a mixed series of deposits. Should the rock in which the cavern occurs be a limestone, the water that trickles in from the crevices will be loaded with carbonate of lime. On dropping down on the floor of the cave, such water will evaporate, and the carbonate of lime will be left to form what are called *stalagmites*. The appearance and peculiar conditions of such caverns will be illustrated by the two or three diagrams I have here. [The Lecturer then referred to a series of drawings of well-known and interesting caverns chiefly in Somersetshire and South Wales. He afterwards referred to another diagram representing a cavern in Sicily, near Palermo, recently described by Dr. Falconer. He then proceeded to describe their contents as follows]:—

In the cavern at San Ciro, near Palermo, there is an enormous deposit of bones. Twenty tons' weight of the bones of the hippopotamus have actually been taken from it within a very recent time for the sake of burning into animal charcoal. Now, it is quite clear that there can have been no accumulation of bones of this kind by human agency. All the hippopotamuses ever brought into Italy by the Romans, if accumulated together, could hardly have sufficed to fill this one cave; and, not far off, bones of 300 individual hippoptamuses have been found in another cave. It is quite clear that the cavern existed for a long period as the habitation and burying-place of the large quadruped whose bones are so abundant. In our own country the caverns have been used for similar purposes. In the limestone rocks in Yorkshire, Devonshire, and elsewhere, there is good proof that they served as dens; for we find in them the remains of bears and hyænas in enormous numbers, and occasionally remains of elephants, rhinoceroses, and hippoptamuses. To illustrate the appearance and condition of the cavern-bones, I have drawn upon the resources of your own museum. Among the specimens before you are teeth and bones of the ordinary inhabitants of caverns. Generally speaking, each cave seems to have been inhabited by one group of animals, and as the caverns have generally been partly excavated by water and partly filled up by aqueous drift, so, in some instances, they have been entirely filled up, and almost obliterated. The Sicilian cave of Maccagnone is a remarkable proof of the accumulation of these bones. There is a bony breccia on the bottom of the cavern, and on the roof of the cavern is another mass, which is really a part of the same breccia as that found on the floor. The whole of this cavern must at one time have been filled with this breccia, which has since been partially carried away by the sea. Now, it is a remarkable fact that human remains have been found mixed up with the fragments of bones at the top of the cave. It seems impossible that they could have got there except as part of the original deposit.

We come next to the raised beaches, of which a large number are known to range round our own coast. An old beach is seen [pointing to a diagram] some feet above the level of high-water; above that there is a deposit of limestone. In this case there is an elevation of only three feet; but in some parts of the coast of Wales the old beach is 1300 feet above the present sea level, and yet it is quite impossible that the accumulation of rolled pebbles and shells so far above the sea can have been deposited in any other way than by slow accumulation at the sea level, at a time when the sea was limited by an ancient coast and cliff, now a mountain side. The whole has since undergone elevation, which has brought the beds up to their present level. As a matter of fact all the way round our own coast, on various parts of the coast of Scandinavia, along the western parts of Europe, and in the Mediterranean, there are unmistakeable evidences of change of level going on, although it is difficult to understand how such changes could have gone on without producing great breaks. There is, however, no break in the succession of life; the animals that belong to one part of the period are traced through all the series of deposits, or else have died out gradually as we get nearer to the new deposits. The raised beaches generally contain shells which we should find at the present day on the actual beach adjacent. There is no possibility of these shells having been carried there by man, for they often cover several square miles of surface, and occupy exactly such level portions eaten by the sea waves out of a cliff which could be easily covered before the elevation. The cliff often presents a succession of steps, produced by the alternate elevation and repose during the time I have alluded to. Raised beaches, therefore, mark great changes during a long time, and the sands, gravels and marls

indicate the time during which such changes were going on. Since, however, we can trace the history of cliffs for hundreds of years, and find the change very small, it becomes difficult to imagine that the same coasts can have acted for a sufficient period to effect the amount of change we see. The remains of animals belonging to the period in question are some of them such as are now only to be found in Africa. We know, indeed, that such animals can live in much more extreme latitudes, and we have a remarkable proof of this in the discovery of the complete carcass of an elephant in the Arctic Seas, provided with a warm coating of hair, showing the adaptation of those animals to a climate perhaps not at all warmer than we have now. However the case may be with regard to climate, we have the remains of the elephant, the rhinoceros, the bear, and the hippopotamus, lions, tigers, and hyænas, and also other animals now altogether extinct, remains of several large kinds of cattle, antelope and deer, one approaching to the reindeer, and others diverging from that type, but all belonging evidently to climates admitting a considerable amount of vegetation, but not necessarily warm.

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, November 5, 1860.

Sir R. I. MURCHISON, *F.R.S., Vice-President in the Chair.*

Carl Haag, was duly elected a member of the Royal Institution.

The special thanks of the members were returned to M. Rouland, the French Minister of Public Instruction, for his present, on behalf of the French Government, of a number of volumes of "Documents Inédits sur L'Histoire de France."

The resignation (on account of ill-health) of the Rev. John Barlow, Honorary Secretary for eighteen years, was announced from the chair, and received by the members with sincere regret.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Quarterly Meeting, October 16, 1860.

Dr. R. ANGUS SMITH, *Vice-President, in the Chair.*

The CHAIRMAN gave a short account of his examination of coal pyrites for arsenic. He stated that although the knowledge of the existence of arsenic in the iron pyrites found in coal may not be considered perfectly novel, it certainly does not seem to be known that arsenic is so widely disseminated as to form an ordinary constituent of the coals burnt in our towns, and chemists of celebrity have held it—and now hold it—to be absent there. He had examined fifteen specimens of coals in Lancashire, and found arsenic in thirteen. He had also found it in a few others; but Mr. Binney having promised a collection, properly arranged, the examination will then be made more complete. Mr. Dugald Campbell had also lately found arsenic in coal pyrites. The Chairman added that this had a very direct bearing on our sanitary knowledge, as we must now be obliged to add arsenic to the number of impurities in the atmosphere of our large towns. It is true that he had not actually obtained it from the atmosphere, but when the pyrites is burnt the arsenic burns, and is carried off along with the sulphur. One or two coal brasses (as they are called) contained copper, a metal that is also to some extent volatilised, as may be readily observed wherever copper soldering takes place. Although an extremely small amount of copper is carried up from furnaces, it is not well entirely to ignore it. The amount of arsenic, however, is probably not without considerable influence, and we may probably learn the reason why some towns seem less affected than others by the burning of coals, by examining the amount of arsenic burnt as well as sulphur.

Mr. SPENCE said that he could confirm the remarks concerning the existence of arsenic in coals, as he had burnt coal pyrites for many years, and had always found a very decided amount of arsenic in the sulphuric acid made from it,

Mr. RANSOME called attention to the peculiar symptoms described by Berzelius, as produced by selenium; and he considered that some similar symptoms were produced in a manner which might be explained if selenium were found in coals.

A paper was read by WILLIAM ROBERTS, M.D., entitled, "On the Estimation of Sugar in Diabetic Urine by the Loss of Density after Fermentation." When a diabetic urine is fermented with yeast, its specific gravity previously ranging from 1030 to 1050, falls to 1009 or 1002, or even below 1000. This result is mostly due to the destruction of the sugar it contained, but partly also to the generation of alcohol, and its presence in the fermented product.

As the diminution of density must be proportional to the quantity of sugar broken up by the ferment, the amount of loss evidently supplies a means of calculating how much sugar any urine contains—always provided that the remaining ingredients of the urine continue unchanged, or become changed in some uniform ratio.

To ascertain the relation between the density lost on fermention, and the sugar destroyed, experiments were made on the urine of diabetic patients on the following plan:—

1. The amount of sugar per 100 parts was ascertained by the volumetrical method, with Fehling's test solution.
2. The density of the urine was taken.
3. Three or four ounces were then placed in a twelve-ounce phial, with a drachm or two of German yeast, and having lightly covered the bottle it was set aside to ferment.
4. In about twenty-four hours the fermentation was finished and the froth dissipated. The density was then taken a second time, and the loss calculated.

Operating in this way on a specimen of diabetic urine specific gravity 1038·60, the following results were obtained:—

Sugar, per 100 parts, by the volumetrical method, 7·69.

Density before fermentation at 60° or D = 1038·60.
Density after fermentation at 60° or D′ = 1005·92.
Density lost, or D — D′ = 32·68.

The relation, therefore, between the density lost and the per-centage of sugar, in this instance, was as 32·68 to 7·69, or as 1 to 0·235. By numerous trials with diabetic urines, of different strength, it was found that the most correct proportion was as 1 to 0·230. The corresponding formula, therefore, was:—

Sugar, per 100 parts, or S = (D — D′) × 0·23.

The accuracy of this method was further tested by operating on diabetic urine diluted with known volumes of water or non-saccharine urine, and on solutions of loaf-sugar in water and in healthy urine.

This method of estimating sugar is especially applicable to medical practice, and the following simple and most convenient rule expresses the result of the analysis:

Each degree of "density lost" indicates one grain of sugar per fluid ounce of urine.

Ordinary Meeting, October 30, 1860.

Dr. J. P. JOULE, President, in the Chair.

A Paper was read by Dr. H. E. ROSCOE, entitled, "On the Alleged Practice of Arsenic Eating in Styria."

Professor ROSCOE, being anxious to obtain further definite information respecting the extraordinary state-

ments of Von Tschudi, quoted by Johnston in his "Chemistry of Common Life," that persons in Styria are in the habit of regularly taking doses of arsenious acid, varying in quantity from 2 to 5 grains daily, was supplied, through the kindness of his friend Professor Pebal, of Lemberg, with a series of letters written by seventeen medical men of Styria, to the government medical inspector at Grätz, concerning the alleged practice. After reviewing the opinions of Dr. Taylor, Mr. Kesteven, and Mr. Heisch upon the subject, and having mentioned the results and conclusions arrived at by those who had previously interested themselves with the subject, Mr. Roscoe stated that all the letters received from the medical men in Styria agree in acknowledging the general prevalence of a belief that certain persons are in the habit of continually taking arsenic in quantities usually supposed sufficient to produce death. Many of the reporting medical men had no experience of the practice; others describe certain cases of arsenic eating which have not come under their personal notice, but which they have been told of by trustworthy people whose names are given; whilst others, again, report upon cases which they themselves have observed. Professor Roscoe proceeded to bring forward, in the first place, evidence bearing upon the question,—Is or is not arsenious acid, or arsenic in any other form, well known to, and distributed amongst the people of Styria? He said that he had received 6 grms. of a white substance forwarded by Professor Gottlieb, in Grätz, accompanied by a certificate from the district judge of Knittelfeld, in Styria, stating that this substance was brought to him by a peasant woman who told him that she had seen her farm-labourer eating it, and that she gave it up to justice to put a stop to so evil a practice. An accurate chemical analysis showed that the substance was pure arsenious acid. Extracts from many of the reports of the medical men were then read, all stating that arsenious acid, called "Hidrach" by the Styrian peasants, is well known and widely distributed in that country. The second question to which Mr. Roscoe sought to obtain an answer was, Whether arsenic is or is not regularly taken by persons in Styria in quantities usually supposed to produce immediate death? The most narrowly examined, and therefore the most interesting case of arsenic eating, is one recorded by Dr. Schäfer. In presence of Dr. Knappe, of Oberzehring, a man, thirty years of age, and in robust health, eat, on February 22, 1860, a piece of arsenious acid weighing 4½ grains; and, on the 23rd, another piece weighing 5½ grains. His urine was carefully examined and shown to contain arsenic; the 24th he went away in his usual health. He informed Dr. Knappe that he was in the habit of taking the above quantities three or four times each week. A number of other cases, witnessed by the medical men themselves, of persons eating arsenic, were then detailed. Dr. Holler, of Hartberg, says that he and other persons, named in his report, guarantee that they are together acquainted with forty persons who eat arsenic; and Doctor Forcher, of Grätz gives a list of eleven people in his neighbourhood who indulge in the practice. Professor Roscoe did not think it necessary to translate the reports *in extenso*; he gave extracts containing the portions immediately bearing upon the two questions at issue, and deposited authentic copies of the original reports with the Society, for the purpose of reference. He concluded that decisive evidence had, in his opinion, been brought forward, not only to prove that arsenic is well known and widely distributed in Styria, but that it is likewise regularly eaten, for what purpose he did not at the moment investigate, in quantities usually considered sufficient to produce immediate death.

In the course of the conversation, after the Paper was read, Dr. Clay mentioned instances in which large quantities of arsenic had been prescribed for various diseases, with benefit. It was a valuable medicine, but if taken for other purposes it would produce most pernicious effects. It was a practice in some parts of the country to give it to horses to improve the sleekness of their coats.

Mr. Ransome confirmed the observation of Dr. Clay, and stated that he had long ago drawn the attention of the Society to the fact that sulphuric acid manufactured from arsenical pyrites contained arsenic, and that this acid being employed in the manufacture of various articles used as medicine, and even as food, these likewise contained the poisonous ingredient. He had found it even in flowers of sulphur.

Mr. Pochin and Mr. Hunt remarked that the effects of breathing the vapour of arsenious acid produced in the smelting of ores were not so injurious as might be expected; occasionally, however, the workmen had to be taken off the particular work for a short time, until the poisonous effect, which manifested itself by eruptions on the face, had disappeared.

CORRESPONDENCE.

On the Spontaneous Decomposition of Chloride of Lime.

To the Editor of the Chemical News.

Sir,—The note published by Dr. Hofmann in the last number of the Chemical News, reminds me of an explosion which took place in my laboratory in Paris, about the middle of last year. A moderately-sized bottle of chloride of lime, which had been for some time unopened upon a shelf in the laboratory, suddenly shot out its glass stopper with a report like that of a large pistol. This happened between twelve and one at night; and hearing it from my bedroom, which was not far distant, I immediately rose and ascertained the cause.

I believe that chloride of lime, which is always more or less damp, decomposes its water and liberates oxygen:—

$$(Ca\,Cl + Ca\,O.\,Cl\,O) + HO = 2\,Ca\,Cl + HO + 2\,O.$$

So that if the bottle containing this compound be not opened from time to time, the accumulated gas makes its escape with explosion.—I am, &c.

T. L. Phipson, Ph.D.

The Chemical Exchange Club.

To the Editor of the Chemical News.

Sir,—I regret to see that the proposition put forward relative to an exchange of specimens of chemical compounds does not appear to have been received with that degree of enthusiasm by my fellow-subscribers which it merits. It strikes me that this slowness to avail themselves of so valuable a suggestion is owing to the want of a due consideration of the mutual advantages which would flow from its adoption; and yet it is difficult to understand how this can be the case, seeing how very obvious they are. Suppose, for example, that I have been preparing a substance which involved the expenditure of much time, and that I have made a great deal more than I want, because it was as easy to make a comparatively large quantity as a small one. Another chemist has been engaged in a similar occupation, only, instead of preparing *a*, he has been making *b*. I do *not* want so large a quantity of *a* as I have got, but I *do* want some *b*, which I must either make myself or buy.

Now, what arrangement could be more mutually advantageous than that I should exchange my surplus commodity for that which I am in want of? Nobody would attempt to dispute the advantage of such an arrangement, if it is feasible; but the difficulty is, that I don't know that Smith has got a great deal more *b* than he requires, or that Jones is similarly overstocked with *c*; and, if I were aware of the fact, I don't know either Smith or Jones,

and the trouble of corresponding with them on the subject would deter me from making the experiment of negotiating an exchange with them. But the case is greatly altered if I can send some specimens of my A to you, and you are kind enought to undertake the trouble of exchanging it for proportionate quantities of other substances of which I inform you I stand in need. The advantage to me of such an arrangement is so manifest that I would gladly forward you a sample with this letter, and such a number of postage-stamps as appeared to me sufficient to pay for the transmission of the packets to Smith and Jones, in exchange for their compounds. To expect that you would voluntarily undertake the labour which this would involve without any remuneration, does certainly appear to me unreasonable. I should, therefore, cheerfully pay a small fee, which would entitle me to the privilege of sending to your office a limited, or unlimited, number of specimens for exchange during one year.

Trusting that other chemists may see the advantages of such a plan as that I propose, with the same force that I do, and that you may be willing to undertake the responsibility of making a just distribution of the specimens sent to your office.—I am, &c. B. S. H.

Restoration of Exhausted Manganese.

To the Editor of the Chemical News.

Sir,—In reply to the letter of your "Subscriber from the First," in No. 46 of the Chemical News, regarding the recovery of exhausted manganese, I beg to say that the process was patented a few years since by the late Mr. Dunlop, of the firm of Charles Tennant and Co., Glasgow. By application at the Patent Office your subscriber can get, to some extent, the information required.—I am, &c.

J. F.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

New Silver Mines.—Don Samuel Molina writes, (*Comptes-Rendus*, t. li. p. 604,) that several rich deposits of silver ore have been discovered in the province of Catamarca, in the Argentine Confederation. On a mountain called Ambato, and on a superficial area of small extent, as many as seventeen *royal veins*,—that is to say, veins, and not threads,—have been found—one of them as much as 5½ metres in thickness. The district is rich in copper mines as well.

Theory of Nitrification.—Nitrification, says M' Millon (*Comptes-Rendus and Cosmos*, t. xvii. pp. 452, 470) is the consequence of a slow combustion which an alkaline ulmate undergoes in the soil. The ulmate absorbs oxygen from the air, and slow combustion being established, the oxidation of ammonia is produced by contact. M. Millon's communication induced M. Pelouse to remark that he had many times seen nitric acid produced when cellulose was dissolved in a cupro-ammoniacal solution.

Supersaturated Solutions of Sulphate of Soda.—Löwel found that when a current of air was passed through a supersaturated solution of sulphate of soda the salt crystallized; but if the air, before it reached the liquid, was made to pass through cotton wool, crystallization did not take place. The explanation proposed was, that in the first case crystallization was provoked by solid matters held in suspension in the air, which, in the second case, were detained by filtration through cotton. M. Terreil (*Répert. de Chimie pure et appliquée*, Sept. 1860, p. 233) has repeated Löwel's experiments many times, and has observed, that sometimes the solution does crystallize when the air has been passed through cotton, and will not crystallize when the air has not been filtered. He found, too, that when the extremity of the tube which dipped in the solution and conveyed the air was heated to 40° or 50° before making the experiment, and then allowed to cool, crystallization did not take place, even when the air was not filtered. The last experiment, the author says, evidently proves that unknown causes exist which determine or prevent the crystallization of supersaturated solutions. An electric current, he adds, seems to have no influence.

MISCELLANEOUS.

Preparation of Sulphate of Soda.—If an extensive and profitable use could be found for chloride of iron, one good mode of obtaining sulphate of soda would be by boiling together solutions of sulphate of iron and salt, until the whole of the chlorine and iron were deposited as an insoluble salt, leaving sulphate of soda in solution, which might then be obtained by crystallisation or evaporation. As, however, ammonia can be abundantly produced in different ways, and effectually fixed by means of sulphuric acid, the best mode of decomposing salt will be by sulphate of ammonia, when the two salts, sulphate of soda and chloride of ammonium, may be obtained separately, each in a state of the greatest purity.—*Jervis.*

Sulphuric Acid and Oxide of Iron.—Solutions are now rapidly evaporated to dryness by forcing warm air through them; in this way a solution of sulphate of iron may be evaporated to a dry granulated salt. An improved furnace has been contrived for decomposing this salt, heated by a blast, which renders any fuel smokeless, and at the same time allows a portion of pure air to be driven over the bed of the furnace. Arrangements are also made for keeping up a continuous supply of fresh material to the surface, and withdrawing from the lower part of the bed portions which have been sufficiently exposed to heat; by means of these arrangements sulphuric acid is driven off, and my be conveyed either to meet other vapours and form compounds, or into chambers charged with steam, where it will condense into liquid acid; the solid portions drawn from the lower part of the furnace will be pure oxide of iron, and may be advantageously employed in preparing copper, reducing the sulphides of lead and zinc, and converting pig iron into malleable iron.

Tungsten Steel.—Franz Mayr has produced, at his cast steel works, at Kapfenburg, in Styria, cast steel of such dimensions, forms, and excellent quality, as could previously only be obtained from Krupp, of Essen. Oblique cog-wheels for coining machines and locomotives, axles for railroad carriages, boiler plates, angle knees, and round, flat, and quadrangular rods of various sections, have now been produced by Mayr, for more than a year. What particularly deserves to be mentioned with regard to these articles is Mayr's unrivalled tungsten steel, distinguished by the fineness of its crystalline texture and its remarkable hardness,—so much so, indeed, that the experiments made with it several months ago have shown that tools made from it for cutting toothed wheels, bores, chisels, punches, turning tools, planing blades, &c., retain their power of cutting four times as long as those made of Huntsman steel, previously regarded as the best. This steel may, therefore, be recommended for these purposes. Tungsten has nearly the same specific gravity as gold, and this density is recognisable in the cast steel alloyed with it, by the alteration in the grain of the fractured surface, and by the heightened ring of the steel. In hardness, metallic tungsten nearly approaches the hardest of natural bodies, and it communicates this property to cast steel, without injuring its tenacity and malleability when the addition is of 2—5 per cent. The absolute solidity of tungsten steel exceeds that of all other known steels; for

fifteen consecutive experiments with a machine, in the Polytechnic Institute of Vienna, showed the highest power of resistance to be 1393 cwts., and the lowest 1015 cwts., giving an average of 1158, 1—3 1—5 cwts. to the square inch; so that this steel exceeds all other kinds hitherto tried. The ore of tungsten, from which the metal is obtained, usually occurs in company with tin stone; it has probably hitherto never obtained any technical application, the only value attached to it being as a specimen in mineralogical or geological cabinets. More recent investigations have shown, however, that the arts may derive considerable benefit from it. One of the richest sources of this ore is possessed by the Austrian Empire in the tin mines of Zinnwald, in Bohemia, where the tungsten ore has been thrown upon the heaps as worthless for nearly five hundred years. Mayr has the great merit of having been the first to bring this new and hitherto unemployed metal into use in the manufacture of cast steel on the large scale, having introduced tungsten cast steel into commerce of the most various degrees of hardness, and of any dimensions. The price of this steel, notwithstanding its remarkable goodness, is lower than that of the English cast steel, over which the uniformity of its crystalline texture gives it a peculiar advantage. The above properties of density, hardness, and strength are also communicated by tungsten to cast iron, and this alloy may probably be useful for crushing rollers.—*Mining Chronicle.*

Field for Chemical Inventions.—Less than five per cent. of all the patents issued are for chemical inventions. The first impression which this fact leaves is that chemists are not so wide awake as mechanics. And it seems, too, as if the chemists would have the best chance, for they have the range of all the combinations, almost infinite in number, of the sixty or more simple substances or elements, while the mechanic is limited in his inventions to the use of only five mechanical elements. But this course of reasoning is a little unfair for the chemist, if we wish to determine his real merit as a benefactor of mankind. If a mechanic is making an invention, he has a definite object in view; he knows, also, precisely the effect of any combination he may make of the resources he has at hand. A skilful mechanical inventor may fully complete his invention in his head, and a few calculations and drawings on paper may accurately represent and demonstrate it to others of equal intelligence. An intelligent mechanic often needs only to be told the new thing to be accomplished, and the means suggest themselves spontaneously; the thought is father of the deed. The search of inventors is rather of things to be done than how to do them. But great chemical inventions are made in quite a different way. The chemist has not such certain data for reasoning as the mechanic; he cannot predict the effect of new combinations; if he have an end in view the way to reach it is not so apparent. The chemist, before trying the experiment, might suspect that chlorine and sodium would unite with each other, but he could not, by any process of reasoning, be able to say that the compound would have the properties of common salt: if it were proposed as a problem to produce salt, an attempt to solve it by reasoning alone, or by empirical trials would be quixotic. It is easy enough to make new combinations of matter, but it is not so easy to find a use for them. New chemical preparations increase at a rate which is bewildering to ordinary people; the mere names of definite compounds which have been discovered in the present century would fill a volume. The chemists who make these new substances are generally men who labour for fame, or from a love of science. Their laboratories are a manufactory and a museum of scientific curiosities, made and labelled only to be looked at and admired. The men who find usefulness in these inventions are quite a different class, for they are matter-of-fact men who care about nothing which does not contribute to our well-being; and it is the discoverer of the utility, quite as much as the original inventor of the process, who confers the substantial benefit on mankind and reaps the reward of money. We all respect science for its intrinsic worth, but it is only practical and useful results of science which the public care about seriously. Abstract science is measured by fame and honour, but applied science by money. We have introduced these speculations chiefly in order to suggest to our readers that, among the myriad of chemical substances for which no use is yet known, they will find very promising opportunities for the exercise of their sagacity. Thus far, the introduction of new substances has been too slow and too much the result of chance. Illuminating gas was known as a chemical product long before any use was made of it; iodine, bromine, chloroform, aniline, and a hundred other things, now common, were for a long time only rare specimens on the shelves of the laboratory, before they were found to be of great public value, and we cannot doubt that much more of the same kind of wealth might soon be developed.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Enquirer.—Very few copies of our first volume now remain in stock, and as the demand for them keeps steady, we shall probably have none left in a month or two; you had therefore better secure a copy whilst you can.

Apprentice.—You can hardly be said to be wrong in dispensing the prescription literally; but as there are many of the older practitioners who still write the old names, a more experienced dispenser would probably have used *Sodæ* and *Potassæ Bicarbonas;* the neutral carbonates being but rarely prescribed for powders.

E. W.—See the article on the subject in the present number.

A Student.—We shall always be pleased to receive any analytical points which you may have determined.

Acetate of Soda.—A correspondent who wrote upon this subject is informed that some large acetic acid maker would be the best customer for acetate of soda. The most likely makers are Beaufoy and Co., Lambeth; Cox and Gould, Whitechapel; Champion and Co., City-road; and Foot and Co., Battersea. Should you still have any difficulty, perhaps an introduction to some Chemical Brokers would enable you to dispose of the salt advantageously.

Vol. II. of the CHEMICAL NEWS, containing a copious Index, will soon be ready, price 8*s.* 6*d.* handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our Office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our Office, or, if accompanied by a cloth case, for 6*d.*

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CHEMICAL SOCIETY OF PARIS.

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CHEMICAL NEWS Office, Red Lion Court, Fleet Street, London.

THE CHEMICAL NEWS.

VOL. II. No. 50.—November 17, 1860.

POISONING BY THE ADULTERATION OF ARTICLES OF FOOD.

SCARCELY a week passes without some fresh case of adulteration resulting in the serious illness, if not the death, of sundry persons. We have had cases of poisoning by beautiful jellies, by brilliantly-coloured sweetmeats, and by rich-looking Bath-buns, and now we have an instance of poisoning by cheese. The matter was briefly mentioned in a recent Number; so that we need only remind our readers that the facts as known are to the effect that the police of Glasgow received information that several persons were lying ill who were supposed to have been poisoned. Doctors were called in, who came to the conclusion that they had been poisoned by arsenic. The next question to be considered was the medium through which it was administered; and the result of the inquiry was, that they had all eaten of a certain cheese, and the symptoms of poisoning had exhibited themselves in such a way as to lead to the inference that the cheese and the poisoning stood in the relation of cause and effect. The shop where it had been purchased was visited by the police, and the remainder of that from which it had been cut was seized, together with all the others in the shop of the same kind. There was nothing peculiar in the appearance of the cheese, we are told; it was what is termed a Dunlop, and bore the outward semblance of being of good quality. Until the analysis is completed we can say nothing as to the quantity of arsenic in it, but that it contains that poison nobody seems to doubt. It is a singular fact that the *Edinburgh Journal of Medical Science*, a few years ago, in an article on arsenic eating, quoted a statement from a German publication, which mentioned that arsenic was used in Styria as a seasoning for cheese, and that several cases of poisoning had occurred from eating cheese which had been prepared with a mixture of this poison.

The indifference which appears to prevail on the subject of the adulteration of food is a striking illustration of the truth of the old adage, that "what is everybody's business is nobody's business." A Member of Parliament introduces a Bill to prevent the fraudulent adulteration of food, and, to give it a chance of being adopted by the House of Commons, he is obliged to make it of such a mild character that its operation is likely to be wholly ineffective even when enforced. Mild as it is, however, the most important of its provisions,—viz., the appointment of a Public Analyst in each parish,—is rendered nugatory by the refusal of most of the Vestries to make the appointment. We pointed out, when the Bill was first introduced, how little likely it was that Vestrymen, who are for the most part tradesmen, would appoint an officer who might prove a source of annoyance to them individually, and would certainly be such to the greater portion of those who elect them to their posts. Our anticipations, judging from what we have been able to ascertain on this point, have proved to be correct. Even in the City of London the appointment was not made without opposition, and in other parishes the existence of the Act seems to be entirely ignored. The motion for appointing a public analyst, in pursuance of the Act, was rejected by one Parish Board, though they seem to have discovered since that one of the principal means of punishing fraudulent tradesmen,—which is almost the only good feature in the Act,—by publishing their names in the newspapers, is provided for by the 36th sec. of the Act 59 George III., cap. 39, and within the last few days they have acted on this by advertising the names of two of this class in the *Times*. Why they should prefer to quote as their authority for doing this a law the existence of which must have been unknown to those who took part in the discussion on that passed last session is best known to themselves; the only apparent motive is that they wished to prove that the new Act was unnecessary. It matters little to the public whether the person who defrauds them is punished under an Act of George or Victoria so that he is punished; but we should like to know how many of Mr. Limebeer's or Mr. Josling's customers saw the advertisement. We presume nobody will pretend that this advertisement will have the effect of putting them on their guard, or that it will prevent these parties from pursuing the same course in future. Had they been compelled to stick a copy of their conviction in their respective windows, or on a conspicuous part of their doorposts, for a certain period, they would be cautious how they offended in future, and it would have been a warning to other tradesmen guilty of similar fraudulent practices.

To expect that the public will endeavour to protect themselves by enforcing the Act just passed is quite hopeless. Apart from the general indifference to such matters, persons do not like to incur the trouble and possible—nay, almost certain—expense of purchasing articles and sending them to an analyst to be analysed. Besides, how are they to know where to find an analyst? He is not a parish official. His name does not figure in the parochial list which careful heads of families have hung up conspicuously in their kitchens, that the cook may know where to send for the turncock when she sets the chimney in a blaze. The whereabouts of an individual capable of detecting the source of the death that is in the pot is, therefore, unknown; and, though Paterfamilias may fume and threaten vengeance against the grocer who has spoilt his breakfast by sending him lie-tea instead of the genuine souchong he had paid for, he will not take the trouble of inquiring for the residence of an analyst, and his indignation passes off in words.

The prevalence of the practice of adulterating articles of food is so generally recognised that it is a mystery how people can be content to let things remain as they are. They know that their tea contains oak, ash, beech, buckthorn, sloe or willow leaves—perhaps some of each; their coffee chicory, burnt sugar, and other abominations; that the arrowroot they take in sickness, and with which

they frequently feed their babies, is adulterated with starch and worse things; and so on through the whole list of substances on which they rely for health and strength; yet they go on consuming them, and make no effort to remedy the evil. Their digestions are injured, they feel unwell without being absolutely ill, and, instead of adopting means to prevent future injury,—which would, at the same time, be the best remedy for the past,—they fly to the patent medicine vendors, and acquire temporary relief at the expense of permanent deterioration of the organs, the healthiness of which is essential to the enjoyment of life.

The only hope of this evil being dealt with effectively depends on the manner in which the public press deals with the question. It is almost useless for one journal to denounce adulterations; it must be taken up by the press universally if Parliament is to be compelled to pass a law which shall be sufficiently stringent in its operation to be of any service. The Act passed last session, we are told, was the insertion of the thin end of the wedge; but if the wedge is to be driven home, the Press must use all its influence to this end, or the Legislature will never attempt it.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Separation of Protoxide of Manganese from Alumina, Lime, and Magnesia, by M. Rose.[1]

In the case of a liquid containing alumina, and protoxide of manganese, add chloride of ammonium, heat to ebullition, pour in caustic ammonia, and boil until the excess of the latter is disengaged; the alumina will then be completely precipitated, and perfectly free from manganese, even when operating with free access of air.

To separate manganese from magnesia, the best plan consists in adding a solution of acetate of soda, heating, and passing a current of chlorine through the liquid, when permanganate is formed. Supersaturate with ammonia, and boil, when all the manganese is reduced to sesquioxide and precipitated, whilst the magnesia remains in solution. If there be a large quantity of magnesia, a certain quantity of sal ammoniac must be first added.

The same process will serve to separate lime from protoxide of manganese.

On the Detection of Bisulphide of Carbon in Coal Gas, by A. W. Hofmann, *Ph.D., F.R.S.*

It is well known that coal gas, even when submitted to the most improved processes of purification, retains a minute quantity of a sulphur-compound, which yields sulphurous acid when the gas is burned. A Commission having been appointed for the purpose of reporting[2] to the Lords of the Committee of Privy Council on Education on the lighting of picture-galleries by gas, and on any precautions (if necessary) against the escape of gas and of the products of its combustion, the writer of this note undertook a few experiments, with the view of determining the amount of sulphur generally present in the London coal gas.

The object of the inquiry being to ascertain the quantity of sulphurous acid capable of being formed by the combustion of the gas, an exceedingly small jet of gas, carefully washed with acetate of lead—which showed the absence of sulphuretted hydrogen — and measured by an accurate experimental meter, was burned in a large two-necked glass globe. Through one of the necks the gas tube was conveyed into the globe, whilst the other, fitting into a condenser, carried off the product of combustion into a two-necked receiver. To establish a current of air, the receiver was connected with a water-current aspirator, a couple of Woolfe's bottles containing water or dilute ammonia being inserted, for the purpose of fixing any trace of sulphurous acid which might escape condensation, with the water, in the receiver. The experiment being terminated, the liquids in the receiver and in the wash-bottles were united, oxidised with chlorine and precipitated with chloride of barium.

Experiments in July 1859.

Order of Experiments.	Quantity of Gas consumed.	Amount of Sulphate of Barium.	Amount of Sulphur in 100 cubic feet.		Amount of Sulphur in 100 cubic metres.
	Cubic feet.	Grammes.	Grammes.	Grains.	Grammes.
I.	1·98	0·0630	0·437	6·74	15·433
II.	2	0·0840	0·577	8·90	20·371
III.	2	0·0630	0·433	6·68	15.278
IV.	2	0·0740	0·508	7·84	17·944
Mean	..	..	0·488	7·54	17·256

Experiments in December 1859, and January 1860.

Order of Experiments.	Quantity of Gas consumed.	Amount of Sulphate of Barium.	Amount of Sulphur in 100 cubic feet.		Amount of Sulphur in 100 cubic metres.
	Cubic feet.	Grammes.	Grammes.	Grains.	Grammes.
V.	2	0·0890	0·611	9·43	21·585
VI.	2	0·0953	0·654	10·10	23·111
VII.	2	0·0975	0·669	10·33	23·644
VIII.	2	0·0935	0·642	9·91	22·677
Mean	..	..	0·644	9·94	22·754

These experiments show that the amount of sulphur remaining in the London gas after the removal of the sulphuretted hydrogen is very small, and that in winter it is somewhat greater than in summer. This may possibly arise from the enormously increased production of gas during the winter months, when it will be more difficult to regulate the several processes involved in its manufacture. But the result may also be purely accidental, arising from a change in the nature of the coal used, &c. A much more extended series of experiments would be required to decide this question.

It has long been assumed that the sulphur in purified gas exists in the form of bisulphide of carbon, the conditions for the generation of this compound being, in fact, given in the ordinary process of producing gas. That coal gas really contains bisulphide of carbon was first elegantly proved by Vogel,[3] who, at the suggestion of Baron Liebig, passed a current of purified gas through

[1] *Annal. der Physik und Chemie*, t. cx. p. 292.

[2] Report on the subject of Lighting Picture-Galleries by Gas, by Professors Faraday, Hofmann, and Tyndall, Mr. Redgrave, R.A., and Capt. Fowke, R.E.

[3] Liebig's *Annalen*, lxxxvii. 369.

an alcoholic solution of potassa, when xanthate (sulphocarbonate) of potassium ($K(C_2H_5)CS_2O$) was formed, which produced in copper solutions the highly characteristic yellow precipitate of xanthate of copper, and yielded, when boiled with a few drops of nitrate of lead in the presence of free potassa, a black deposit of sulphide of lead. When engaged in the above inquiry, I repeated Vogel's experiments, which I can confirm in every particular. The amount of bisulphide of carbon in the London gas is, however, so small that a very large volume must be passed through the alcoholic solution of potassa in order to produce a sufficient quantity of xanthate of potassium. After a cubic foot of gas had been passed through alcoholic potassa in a bulb apparatus, the solution gave with sulphate of copper a leek-green precipitate, in which the presence of xanthate was but imperfectly indicated. Only after passing several additional cubic feet the yellow colour became more distinct, although still masked to some extent by the hydrated protoxyde simultaneously precipitated. On the other hand, the black precipitate of sulphide of lead was obtained without difficulty, even after the passage of one single cubic foot of gas.

But the presence of bisulphide of carbon in coal gas may be exhibited even more elegantly, and with greater precision, by means of *triethylphosphine*, which produces with the bisulphide a compound crystallizing in splendid prisms of a ruby colour. This body is so characteristic, and forms with so much facility, that bisulphide of carbon has become a most valuable re-agent for triethylphosphine and its homologues. The idea naturally suggested itself to employ the phosphorous-base for the detection of bisulphide of carbon in gas. On distilling a considerable proportion of coal-gas-benzol, I had separately collected a small fraction, which came over in the commencement below 65°. When mixed with triethylphosphine, this liquid solidified into a mass of the well-known ruby crystals. Four or five drops of triethylphosphine were dissolved in ether, the ethereal liquid was introdnced into a bulb-apparatus, and a current of coal gas allowed to bubble through the solution. When 0·2 of a cubic foot had passed, the liquid had assumed a distinctly red coloration, the intensity of which increased as the passage of the gas and the evaporation of the ether continued. After 0·8 of a cubic foot had passed, the whole of the ether had evaporated, and the inner surface of the bulb-apparatus was lined with a beautiful network of the ruby crystals. —*Quarterly Journal of the Chemical Society.*

On the Volumetric Determination of Antimony, by M. SCHNEIDER.[1]

THE Author bases his process on the transformation which sulphide of antimony undergoes in the presence of hydrochloric acid. He receives into ammoniacal water, containing no dissolved oxygen, the sulphuretted hydrogen which is evolved, and estimates this volumetrically by means of hydrogen in the ordinary way. The following are the practical details:—

The recently precipitated sulphide of antimony is collected on a filter and washed with warm water; when the precipitate is tolerably dry it is rolled up in the filter-paper and introduced into a long-necked retort, having a globular receiver attached to it, filled with boiled water, containing 30 to 50 cubic centimètres of a concentrated solution of ammonia, which should be in excess even after the operation is terminated.

The decomposition of the sulphide of antimony is effected by means of an excess of hydrochloric acid. When the operation is terminated allow the ammoniacal liquid to cool, and transfer it to a flask of known capacity, then add boiled distilled water to make up the bulk to ½ or 1 litre. Take a known volume of the liquid, dilute it with an equal bulk of water, and add dilute sulphuric acid to a faint acid reaction, next add starch paste, and finally the standard solution of iodine, as in the ordinary method for estimating sulphurretted hydrogen. By this means the amount of sulphur contained in the SbS_3 can be found. From this the amount of antimony can easily be calculated by means of the formula,

$$X = \frac{Sb}{3HS}.a\,t,$$

in which a represents the sulphurretted hydrogen, corresponding to 1 cubic centimètre of tincture of iodine, and t the number of cubic centimètres of iodine solution which have been consumed.

Another process for estimating the sulphuretted hydrogen consists in employing a standard solution of arsenite of soda, prepared by dissolving pure arsenious acid in a dilute solution of soda. This solution is substituted for the ammoniacal liquid mentioned above. In contact with the sulphurretted hydrogen there will be precipitated a proportionate quantity of arsenic in the state of sulphide. Knowing the amount of arsenic employed, it is easy to determine the quantity which has been precipitated, and to deduce from this the quantity of antimony. It must, however, be remembered when the remaining arsenical liquid is diluted in order to estimate it by the standard iodine solution, that a little tartaric acid should be added, otherwise the sulphide of arsenic will retain energetically small quantities of chloride of arsenic. The same precaution must be taken when the sulphide of antimony is to be precipitated in the first instance in order to prevent the sulphide of antimony from retaining chloride.

[We have given the above process, as it has already attracted some little attention amongst chemists; but we really cannot see that anything is gained by employing it. Doubtless, antimony could be estimated volumetrically in this manner; but, in our opinion, it would not take one-fourth the labour and time, and would yield far more accurate results, to dry and weigh the precipitated sulphide of antimony when first obtained.—ED. C. N.]

[1] *Annal. der Physik und Chem.*, t. cx. p. 634.

TECHNICAL CHEMISTRY.

On the Preservation of Flesh, by VERDEIL.

HAVING been separated from the bones, and, as far as possible, from fat, the flesh is cut into slices from one to five centimetres (one centimetre = 0·3937 inch) in thickness; the slices being cut as nearly as possible across the grain of the flesh. These are now laid upon hurdles of basket-work, which are subsequently placed in a chamber. As soon as a sufficient number of the trays have been introduced into the chamber, it is closed, and steam under a pressure of three or four atmospheres, consequently of 135° to 145° C. [= 275° to 293° F.] is admitted through several openings.

The chamber, which may be of lead or iron, must not

be absolutely tight, a small outlet for the steam being necessary, in order that the pressure may not become too great.

After from six to ten or fifteen minutes, according to the kind of flesh and the thickness of the slices, the steam is shut off, this part of the process being finished.

The flesh is now very nearly in the condition of boiled meat, but has retained all of its ingredients, the albumen having been coagulated: its taste recalling that of roasted meat. It presents a wrinkled appearance, is of a grey colour, and may be readily divided.

Being removed from the steam chamber, the flesh is now placed upon trays, or hung upon hooks, in another chamber, which is warmed, but in which the temperature is never allowed to exceed 40° or 50° C. [= 104° to 122° F.] The drying process is completed in the course of eight or twelve hours.

Packed in tight casks or in tin boxes, so that it may be protected from the action of moisture, and from insects, the flesh thus prepared may be preserved for any length of time which may be desirable. It is nevertheless well to place a layer of salt in the casks, in order that it shall absorb any moisture which the flesh may have retained. Before using this meat it must be soaked for an hour or two in warm water in which it softens and regains its original condition. When boiled with water it affords an excellent soup, and passes into a condition in which it cannot be distinguished from fresh meat.—*Le Génie industriel, Boettger's polytechnisches Notizblatt*, xv. 71.

PHARMACY, TOXICOLOGY, &c.

On the Different Kinds of Metallic Iron used in Medicine, by M. Deschamps.[1]

Among the most esteemed therapeutic agents the ferruginous preparations certainly occupy a high rank. But experimenters are not unanimous in the choice which should be made when prescribing iron in a metallic state. Old practitioners were limited to iron filings only, more or less fine. Their successors added levigated iron; while, at the present time, iron reduced by hydrogen ranks among therapeutic agents.

Iron filings are now rarely prescribed. Pulverised iron is more frequently ordered; but now practical, enlightened, or young doctors prescribe only iron reduced by hydrogen. According to them it is the only form in which iron should be prescribed. This diversity of opinion on so simple an agent as iron, appears singular, and it may be useful to see whether chemical investigation cannot elucidate the therapeutic value of these irons, and show that, perhaps, some prejudice exists in favour of old formulæ, and to demonstrate that the iron held in most estimation is not what it is thought to be. In therapeutics proportional numbers are as useful and important as in chemistry. Unfortunately they are too often, or rather they are always, neglected.

When iron filings, or levigated iron, is prescribed, it is understood that patients receive identical preparations; but this is not the case when iron reduced by hydrogen is given; for all examples of iron thus reduced do not possess the same physical and chemical properties, and probably would not, in a given time, produce like chemical results.

[1] *Journal de Pharmacie et de Chimie*, t. xxxviii. p. 250.

It is generally admitted that there are at least six species of metallic iron: iron filings, levigated iron, and four kinds of iron reduced by hydrogen. Considering the order of their introduction into the Materia Medica, let them be designated by the numbers 1, 2, 3, 4, 5, 6. According to this arrangement, iron filings take No. 1, levigated iron, No. 2, and the irons reduced by hydrogen, Nos. 3, 4, 5 and 6.

Iron filings are white and glittering when well preserved; their metallic lustre is very marked, and they are low priced. Levigated iron is grey, with numerous shining metallic points. All the species of hydrogen-reduced iron are of a slaty-grey colour, more or less deep. Nos. 3 and 6 so much resemble each other that it is difficult to discover any dissimilarity. No. 4 is rather darker, and No. 5 is black.

Hydrogen-reduced irons, when brought into contact with a lighted body, touchwood, a burning match, or the flame of a spirit-lamp, take fire and burn without flame. They are all alkaline,[2] and turn reddened litmus-paper blue. They still contain lime, &c. When heated in small glass tubes they all, even levigated iron, evolve aqueous vapour. Their price is high compared with that of the two other kinds.

When treated with an acid, all these metallic irons disengage sulphuretted hydrogen, but it is produced most abundantly from the reduced irons. Yet there are some which disengage but infinitesimal portions. We will explain further on the cause of this difference.

Many chemical experiments could be performed to elicit the therapeutic properties of metallic irons, and to enable us to indicate to practitioners those most serviceable to them; but we will single out the combination of iron with iodine, having regard to the proportion of iron which should be put in contact with a given weight of iodine in order to transform this metalloid into iodide of iron, and the determination of the volume of hydrogen produced by the same weight of iron. We have not estimated the sulphuretted hydrogen evolved by the irons while dissolving in acids, because it is very easy to discover any notable difference in the proportion of this gas by the odour, by acetate of lead papers, and by the reaction which the disengaged gas would exercise on the surface of the mercury in the receiver.

The Action of Iodine on Iron.—Prepare a standard solution with iodine, iodide of potassium, and water, so that 40 cubic centimètres represent 1 gramme of iodine; and shake for thirty minutes in well-stopped flasks, 40 cubic centimètres of this liquid and 30 centigrammes of iron, a rather larger proportion than theory indicates. The following are the results obtained:—

1. Filings from Viergon iron smelted by wood. This is the purest iron procurable. The iodine is converted into iodide of iron in less than thirty minutes.

The ordinary filings of commerce do not entirely decolorise the standard liquor: 20 centigrammes more must be added, in two portions, to produce this effect.

2. Levigated iron produces incomplete decoloration. The addition of 20 centigrammes more, with twenty minutes' shaking, do not suffice: but the superaddition of 10 centigrammes will be found to complete the reaction in a few minutes. Set aside the flask containing the iodide of iron. Thirty-six hours afterwards decant the liquid, and put in its place 10 cubic centimètres of a liquor containing 1 gramme of iodine for every 25 cubic centimètres, and the decoloration will

[2] Reduced iron is not itself alkaline; the alkalinity is due to the carbonate employed to decompose the salt of iron, and which remains mingled with the oxide.

be instantaneous. The difference between the action of the iron filings and that of levigated iron proves that the latter, though bright, still contains a little oxide which opposes for some time the action of the iodine; but as soon as the resistance is destroyed, and the iron free from oxide, it recovers its intensity of action.

The levigated iron used was not impregnated with oil, for a portion washed in ether left no residue after evaporation.

If the experiment is repeated, by employing at one time 50 centigrammes of iron, instead of 30, the conversion of iodine into iodide is not totally effected after thirty minutes' shaking: it is accomplished in a rather longer time. Generally, the time necessary for effecting the combination of iodine with iron is, other things being equal, in an inverse ratio to the quantity of iron employed.

3. Reduced iron. Decoloration very little advanced even after forty minutes' shaking. After the addition of 30 centigrammes of iron, and twenty minutes' shaking, the combination will be found advanced, but not finished. By introducing into the flask 10 centigrammes more iron, and again shaking it, decoloration is soon accomplished. Thus, 70 centigrammes of a highly-esteemed sample of reduced iron are often required to produce the same effect as 30 centigrammes of iron filings. When the flask is left to itself, the iron is deposited, aggregates into a mass, and on the third day after all the liquid can be easily decanted. Then, if a standard solution, containing 1 gramme of iodine for every 25 cubic centimetres, is poured into the flask and briskly shaken, the decoloration is effected in a few instants.

In explanation of these phenomena it may be supposed that the molecules of iron reduced by hydrogen, under the influence of the temperature necessary for the reduction, and which may become considerably raised independently of the operator, acquire properties which render them passive; but to us it appears more simple and feasible to admit that, on the surface of the molecules there is formed sometimes a coating of oxide, sometimes a coating of sulphide, which for a time checks the action of certain chemical agents, for the molecules recover all their properties as soon as they are modified by the first reaction. If the addition of the iodised solution is continued, so as to convert the iron into iodide, with an excess of iodine, and the residue is washed to remove the iodide, no more sulphuretted hydrogen is obtained when it is treated by acid. It may be thought the iodine remaining in the residue in a state of sub-iodide will suffice for decomposing the sulphuretted hydrogen, but this is not the case: the proportion of sulphuretted hydrogen disengaged by the reduced iron is too considerable to be decomposed by the iodine, which remains in the state of sub-iodide.

4. The decoloration is scarcely appreciable. The addition of 30 centigrammes of iron, with twenty minutes' shaking will not complete the transformation of iodine into protoiodide of iron. Even 10 centigrammes more are not sufficient; but another 10 centigrammes being superadded, making the weight of the iron 80 centigrammes, the reaction is promptly finished. The difference between this iron and the preceding is easily explained; its colour is deeper and it contains more oxyde.

5. Black reduced iron, with no apparent reaction. The addition of 150 centigrammes of iron will not effect the decoloration of the test-liquor.

6. This reduced iron behaves in exactly the same manner as No. 3.

Hydrogen Obtained with a Given Weight of Iron.—This gas was collected over mercury in a graduated receiver, and its volume was reduced by calculation to the normal pressure and temperature.

1. Of Viergon iron, 10 centigrammes taken; disengaged gas, 39·11 cubic centimètres, or 391·1 cubic centimètres per gramme. Surface of the mercury undimmed.

2. Levigated iron, 10 centigrammes; disengaged gas, 37·672 cubic centimètres, or 376·72 cubic centimètres per gramme. The surface of the mercury undimmed.

3. Reduced iron, 10 centigrammes; disengaged gas, 34·622 cubic centimètres, or 346·22 cubic centimètres per gramme. The surface of the mercury altered, brown and violet-coloured.

A second experiment with 11 centigrammes of iron from another flask; disengaged gas, 36·711 cubic centimètres, or 333·736 cubic centimètres per gramme. The surface of the mercury altered, brown and violet-coloured.

4. Reduced iron, 20 centigrammes; disengaged gas, 37·284 cubic centimètres, or 186·42 cubic centimètres per gramme. The surface of the mercury very brown.

5. Reduced iron, 20 centigrammes; disengaged gas, 2·9029 cubic centimètres, or 14·5145 cubic centimètres per gramme. The surface of the mercury bright.

6. Reduced iron, 10 centigrammes: disengaged gas, 34·0098 cubic centimètres, or 340·09 cubic centimètres per gramme. The surface of the mercury very brown and violet-coloured.

Second Experiment:—Reduced iron, 11 centigrammes; disengaged gas, 36·874 cubic centimètres, or 335·218 cubic centimètres per gramme. The surface of the mercury very brown and violet-coloured.

Third Experiment:—Reduced iron, 10 centigrammes; disengaged gas, 20·6504 cubic centimètres, or 206·504 cubic centimètres per gramme. The surface of the mercury bright.

This last iron produces but a very small quantity of gas, nevertheless it has all the appearance of very good reduced iron; it is of a clear slate-grey colour; it disengages but an infinitesimal proportion of sulphuretted hydrogen; it burns in contact with an ignited body, but it does not burn so readily as Nos. 3, 4, and 6, and its molecules are agglomerated in the form of little grains, containing red oxide of iron.

All the chemical properties of this variety of reduced iron No. 5 evidently prove that it is prepared as a sample with more care than the other varieties, but it was badly preserved. The person from whom it was obtained was doubtless deceived by its aspect, and gave it to us because he knew it had been carefully prepared, and because we did not conceal from him that we were studying the reduced irons of commerce. We were greatly surprised to see that he took it from a packet, and to find that reduced iron, which should be preserved in small quantities in well-stopped bottles, is generally kept in paper.

From the preceding results the following conclusions are deducible; they evidently flow from the facts contained in this paper:—Of all metallic irons, filings from the iron of Berry, prepared by wood, possesses medical properties in the highest degree. It should be preferred by all therapeutists. It evolves but a small quantity of sulphuretted hydrogen, combines easily with chemical agents, and is much the cheapest. After Berry filings rank in order of their therapeutical properties common filings, levigated iron, reduced iron Nos. 3 and 6, and

then No. 4. No. 5 ought to be rejected as a metallic iron; it might replace black oxide of iron, which always contains metallic iron when not prepared by double decomposition.

[May it not be inferred from the facts contained in the interesting paper of M. Deschamps, and also from the important work which M. de Luca is about to publish, that among ferrugineous preparations hydrogen-reduced iron is least to be relied on by physicians? The constant presence of sulphide of iron, in more or less considerable proportions, to which the odour of sulphuretted hydrogen is due, renders hydrogen-reduced iron a remedial agent which certainly does not merit the high estimation in which it is held. Every experiment, and, above all, those lately performed by M. F. Boudet,[3] prove that among ferrugineous preparations lactate of iron merits the preference.—T. G.]

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY, *November 1, 1860.*

G. B. Buckton, *Esq., F.R.S., in the Chair.*

The minutes of the last meeting were read and confirmed. Rowlandson Cartmell, Esq., was elected a member of the Society.

Mr. H. C. Sorby, F.R.S., gave an account of some "*Artificially-prepared Pseudomorphs.*" In the Chemical News for June 30, 1860 (vol. ii. p. 35), we gave a full account of some of Mr. Sorby's experiments on the action of prolonged heat and water on different substances. The present account was of experiments in continuation of the above-named researches. He had succeeded in determining the law of their formation, and had prepared in consequence, many interesting Pseudomorphs. The method of formation was to heat the crystal whose pseudomorph he wished to make, with a solution capable of producing the desired body by double decomposition with the crystal. These two substances, the crystal and the liquid, were sealed together in a glass tube, which was then placed in a high-pressure boiler, where it could be exposed to a temperature of 150° C. for many months. It was of importance to prove that a moderate temperature was capable of producing very considerable chemical changes at the end of a sufficiently long time. When these artificial pseudomorphs were examined under the microscope it was seen that they resembled those of nature; a multitude of distinct crystals was perceived, adhering strongly to one another. Many beautiful and interesting pseudomorphs could be obtained at the ordinary temperature. Thus the carbonates of copper, zinc, and lead could be obtained in the form of carbonate of lime; sulphate of baryta in the forms of gypsum and carbonate of baryta; and carbonate of lime in the form of gypsum.

Under other circumstances, when there was no action at the ordinary temperature, the pseudomorphs were obtained at a high temperature; and in that case the chemical reactions were frequently the direct reverse of what took place at a lower temperature. For example, at temperatures between 100° and 150° C., the author obtained the carbonates of iron and of magnesia, in the forms of iceland spar, arragonite, and carbonate of baryta; also carbonate of lime in the form of carbonate of baryta and of fluor spar; the carbonates of baryta and of strontia in the forms of their sulphates; and silicate of lime in the form of carbonate of lime.

By two successive operations it was possible to completely remove and replace all the elements of certain crystals; thus the carbonates of copper and of iron were produced in the form of gypsum.

The following were some of the reactions which had been effected in this manner by Mr. Sorby:—A crystal of gypsum placed in a solution of carbonate of soda became gradually converted into arragonite; a crystal of calcite placed in a solution of chloride of zinc, became at the ordinary temperature converted into carbonate of zinc in the crystalline form of calcite; calcite in chloride of copper gave carbonate of copper in the form of calcite; a crystal of sulphate of baryta in a solution of carbonate of soda gave, by being kept for months in a temperature of 150° C., carbonate of baryta in the crystalline form of the sulphate; fluor spar in a solution of carbonate of soda gave carbonate of lime in the crystalline form of the fluoride; calcite in silicate of soda, gave silicate of lime in the form of calcite; carbonate of iron in the crystalline form of selenite was obtained by first converting the selenite into carbonate of lime by means of solution of carbonate of soda, and then by placing this carbonate of lime in a solution of chloride of iron, when it became carbonate of iron. Many beautiful specimens of these pseudomorphs were exhibited at the meeting; amongst the most remarkable was a large crystal of carbonate of copper in the crystalline form of calcite. It had exactly the appearance of malachite, and if this reaction could be effected as successfully on the large scale as in working with the small quantities, very beautiful and valuable lumps of malachite might be thus formed.

Mr. Sorby then gave an account of experiments which he had made on the prolonged action of heat and water on different kinds of glass and wood. As, however, these did not differ materially from what we have already given, as above stated, we need not allude to them further.

In the discussion that followed,

Mr. Riley asked what kind of glass tube Mr. Sorby had used, as he had found that specimens kept for six weeks in a high-pressure boiler were considerably acted on.

Mr. Sorby said that he used a particular kind of glass tube, which had been made by Messrs. Chance, of Birmingham, for the pressure gauges of steam-boilers. This was very little acted on; whilst, under the same circumstances, German combustion-tubing was very much attacked by the water. He had also noticed that a small quantity of water in the tube was more energetic in its action than a large quantity. This was accounted for by the vapour of water which filled the upper part of the tube having stronger disintegrating powers on the glass than the water itself, which, besides, was gradually losing its solvent power in proportion as it became saturated.

The following papers were then read:—

By *Professor* Bolley, "*On the Discrepancies in the Statements of Pelouze and F. Mohr, respecting the Solubility of Gallotannic Acid in Ether.*" Pelouze considered the viscid liquid obtained by treating nutgalls with ordinary ether in a displacement apparatus, as a concentrated aqueous solution of tannic acid, and the lighter liquid, which separates from the former and floats over it, as ether holding small quantities of tannic acid and colouring matter in solution. Mohr, on the contrary, has represented the thick liquid as a concentrated solution of tannic acid in ether, and the light liquid as a weak solution of tannic acid in ether. The author finds that neither of these statements is strictly correct, the thick viscid liquid being a solution of tannic acid in a mixture of equal volumes of ether and water. He found that absolute ether dissolved only 0·206 per cent. of tannic acid at 5° C.

By *Professor* Bolley, "*On a Hitherto Unobserved Source of Paraffin.*"—The author observes that paraffin has hitherto been considered a product of the action of heat on certain vegetable and mineral substances. In some experiments made in the Technical Laboratory of the

[3] *Journal de Pharmacie et de Chimie*, t. xxxiv. p. 265.

Swiss Polytechnic School, on the varieties of coal used for the production of illuminating gas, Boghead shale was treated with various reagents for the purpose of extracting some of its proximate constituents. With ether it yielded an extract containing a substance which the author considers to be paraffin. He thinks it probable that paraffin exists, as such, in several of the materials from the distillation products of which it has hitherto been prepared, such as peat, shale, lignite, &c., and that the process described affords a convenient method of testing such substances for its presence.

The President announced that the next meeting of the Society would take place on November 15, when papers would be read by Messrs. Field, Roscoe, and Bolley.

PHARMACEUTICAL SOCIETY,

Wednesday, November 7, 1860.

T. N. R. Morson, *Esq.*, *President, in the Chair.*

Mr. Hilles exhibited a specimen of *Luteana Oil*,—an aromatic oil, the product of some species of andropogon, growing in India.

Mr. Deane explained the way he had been informed these oils were obtained. A large quantity of the grass was collected and placed in a cauldron with some water, which was then raised to the boiling point. The oil then separated and was skimmed from the surface.

The Chairman doubted whether an essential oil could be separated in the way stated without distillation. The experiment was worth trying, for, if it answered, it would enable experimenters to obtain essential oils, where a distillatory apparatus was not procurable.

A paper "*On the Comparative Value of Barbadoes and Socotrine Aloes*," by Mr. R. B. Giles, of Clifton, was then read. Mr. Giles doubts whether the comparative value of Barbadoes and Socotrine aloes is fairly represented by their positions in the London Pharmacopœia. Socotrine aloes yield but 56 per cent. of aqueous extract, while Barbadoes will give as much as 80 per cent., and that kind the author believes to be the best which yields the largest amount of aqueous extract. Messrs. Smith, of Edinburgh, have found that aloine is prepared with greater facility from Barbadoes than from any other kind of aloes; and as the purgative property of the drug is supposed to be due to the aloine, that kind must necessarily be the best which yields the largest amount of the active principle. The author has substituted Barbadoes for the Socotrine in the various aloetic pills of the Pharmacopœia, and has found the action of the preparations to be much improved by the change. It is worthy of remark, too, that Dr. Marshall Hall preferred the Barbadoes for his pilula aloes diluta; and Dr. Pereira observes, in his Materia Medica, that although the Socotrine has long been regarded as the best, he believed it to be inferior to the Barbadoes. A traditional preference, the author remarked, always attaches to articles scarce in the market, and this he thought was the chief reason why Socotrine aloes were preferred to the Barbadoes.

Mr. Simmonds said that the superiority of the Barbadoes aloes was probably owing to the pains taken in the cultivation. The plant was grown, and the extract was prepared, by negroes, who were small holders of land, and who bestowed great care both on the plant and the preparation of the extract. Cape aloes was the produce of a wild plant.

Professor Bently thought the real reason why Socotrine was preferred was the agreeable aroma it possessed, from which it was inferred that it must have a more agreeable action. From Dr. Pereira's experiments, and those of Dr. Clutterbuck, it would appear that there was really no difference in the action of the various kinds of aloes on man; but it must have been from observing the better effects of it, that the Barbadoes was universally preferred for animals. With regard to aloine, he had observed that the crystals of that body obtained from the different kinds certainly differed in size, and somewhat also in form.

Mr. Deane said that when aloine was heated up to a certain temperature the crystals were destroyed. He did not believe that the purgative property of the drug depended on the aloine, for Socotrine aloes, from which aloine could not be made, purged as well as the others. He added, that he had found the preparation of Dr. Marshall Hall's pill, the pilula aloes cum sapone of the present Pharmacopœia, was much improved by the addition of a few drops of liquor potassæ when making the mass. In this way a perfectly homogeneous mass that always rolled well was obtained, which was not the case when the Pharmacopœia form was strictly adhered to. The reason of this, he thought, was, that the acid in the treacle effected some decomposition of the soap, which was prevented by the use of the liquor potassæ.

The Chairman remarked that the whole subject of aloes was one of great importance, and deserved an extended study. Barbadoes aloes was preferred, because the aloine was most readily obtained from it, and aloine was supposed to be the active principle of the drug. This, however, was disputed by M. Robiquet and other Continental writers, some of whom asserted that it was not a purgative. He repeated that the question was a most important one, the chemistry of which was worthy to be made the subject of a prize essay. The aloine found in commerce was a light yellow crystalline powder, which was used as a purgative; but how it was prepared on the large scale he did not know. The liquid juice of aloes imported deposited it in large quantities.

The next paper was "*On Acetic Acid as a Menstruum for Exhausting Ipecacuanha*," by Mr. Johnson, of Birmingham. Looking for a cheap menstruum for dissolving Emetina, the author found that it was readily soluble in acetic acid, and it at once occurred to him that the same acid might be available for the preparations of ipecacuanha. He accordingly tried the experiment of digesting two ounces of ipecacuanha-root with five fluid ounces of acetic acid, and thirty-five ounces of water for twenty-four hours. The liquor obtained was of a rich brown colour, and was found to have double the strength of the Vinum Ipecacuanhæ of the Pharmacopœia. It was a good expectorant, and an active emetic, fifteen drops being an emetic dose for a child. On neutralizing with ammonia and adding tannin, a much larger precipitate was obtained than with the wine. The acetic acid preparation, the author thought, possessed several advantages over the Vinum. It was cheaper, it could be made of an uniform strength, and it will keep a much longer time without changing or depositing. He thought it might be entitled to a place in the forthcoming Pharmacopœia.

The Chairman was inclined to think the preparation a very useful one. It was very probable that all the emetina in the ipecacuanha root was taken up by the acetic acid.

Mr. Deane thought the acid of the wine important, and wine, therefore, a better menstruum than spirit.

A Member contended that a tincture of ipecacuanha prepared with proof spirit was even more efficacious than the wine.

Another Member suggested that, as emetina was soluble in water, a syrup was the best preparation which could be used. The last remains unchanged and never deposits.

A paper "*On the Medicinal Uses of Glycerine, and its Advantage for Preparations Containing Protocarbonate of Iron*," was deferred until the next meeting.

The meeting then adjourned.

CORRESPONDENCE.

Non-Inflammable Fabrics.

To the Editor of the Chemical News.

Sir,—Being the licensees under the patent for the manufacture of the Tungstate of Soda, for the purpose of rendering fabrics non-inflammable, we beg to answer a question raised in the Chemical News of December 17, 1859, as to the exact way of using it. This salt, on account of its being mixed with a small proportion of an insoluble substance, which, adhering to the surface of the cloth, facilitates the ironing thereof, does not give a perfectly clear solution, and must be well stirred, with the necessary quantity of warm water. It is sold in packets containing sufficient for either half-a-gallon or a gallon of water. A sheet of linen is first soaked in the solution and dried. The articles of dress or curtains, after being well starched, blued, and rough dried, are afterwards soaked in it until fully saturated. They must then be rolled in the sheet of linen, prepared as above directed, and ironed in the ordinary way. For goods that are not to be ironed, sulphate of ammonia, the subject of another patent, would deserve the preference.

The reason why we do not mix the salts with the starch is chiefly that such a mixture does not completely impregnate the cloth, which would therefore be likely to remain inflammable.—We are, &c. Briggs & Co.

20, Great Peter Street, Westminster.

Combinations of Hydrogen with Iron and Zinc.

To the Editor of the Chemical News.

Sir,—Owing to my being absent from Ireland, it is only now that my eye catches a letter signed "X. Y. Z." in your issue of the 15th ult. Your correspondent rather, I think, contradicts himself when he alleges that no general good results from the publication of an account of mere "failures." Why, Sir, if my failures in this particular had not been made public, where would "X. Y. Z.'s" letter have been? And what to the public of the general good which it cannot fail to have derived from the perusal of his luminous production.

No doubt it is much more satisfactory to the experimenter, and to the world of science, to have to chronicle successes rather than failures. But I venture to assert that what may, from one point of view, be regarded as a failure, may from another be looked upon as a decided success. If, for example, after using all the proper means in certain circumstances, for accomplishing a given end, I *fail* to do so, I *succeed* in proving that the circumstances in question are adverse to the end sought. If there be three or four *supposed* ways of reaching a sought end, but only one *real* one; if after suitable endeavours I *fail* to reach the end by three out of the four ways, my "failures" are successes in the direction of demonstrating which is the one true way. I do not think, then, that such "failures" of scientific men, are to be altogether despised or overlooked, even should such critics as "X. Y. Z." fail to see what they are intended to prove. So much for *negative results*, which are, in the hands of competent men, so easily turned to *positive* account.

But the article which elicited so positive a result as your correspondent's letter, was not intended to detail the regular results of my attempts to form compounds of iron and zinc with hydrogen; but to show that such compounds were not formed under specific circumstances alleged by certain writers. Booth, in his "Encyclopædia of Chemistry" (1852), stated that ferruretted hydrogen is formed during the dissolution of iron in dilute acids; and Hunt, in his popular work, "The Poetry of Science" (1854), pointedly alludes to a compound of iron with hydrogen. Six years ago I was induced to test those statements by experiments, which were then read at a meeting of the Dublin Chemical Society. Something like your correspondent, I did not consider that I had done anything so very wonderful as to entitle me to expect that a sensation would be created in the scientific world by a publication of my negative results; and so, until lately, those particular labours remained unknown to the public.

My experiments were not, as your correspondent alleges, based upon the supposition that the combinations of hydrogen with the metals must be gaseous. He will find no such idea in my paper. Wurtz's experiments twenty-five years ago, so needlesaly referred to by your correspondent, were well known to me, as, indeed, they could scarcely fail to be to the merest tyro in Chemistry; and a modification of his method of combining a metal with hydrogen was tried by me, but I found it inapplicable to zinc and iron, probably from their being much more electro-positive than copper.

"X. Y. Z." is as serious in his consideration of my remarks, as if I had undertaken to prove the utter impossibility of forming a gaseous combination of hydrogen with iron or zinc. Might I ask, if "X. Y. Z." would regard it as very unphilosophical if I were to state that it was utterly impossible to chemically combine metallic iron with sulphate of soda?—I am, &c.

Charles A. Cameron.

Dublin.

Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—It is perfectly true, as Mr. Barrett has it, that philosophers reason synthetically and analytically; but it does not follow that they should use these as entirely distinct and separate means. Much more satisfactory and accurate results are often obtained—more especially with subjects which do not admit of complete synthesis—by combining the two great methods. Another method of reasoning, and which can scarcely be classed under either of the above, is that of reasoning by analogy, and this is in very many cases the most perfect finger-post to the latent truths of science.

Were philosophers to reason in that naked-eye, and finger-touch fashion in which Mr. Barrett seems to indulge, Investigation would be a hopeless invalid, and Discovery little more than a dead letter. The distant nebulæ still undisintegrated into their component stars or systems, would be simply a slight phosphorescence, a mere luminous haze in space; the mountains and valleys of the moon's surface simply little flaws or scratches, very probably produced by a pen, a pencil, a graver, or some such small instrument.

The arguments in favour of ultimate atoms are so well known, that they do not here require recapitulation; they bear with them the stamp of earnest and deep scientific investigation, which give results that cannot be affected by a mere dogmatic paper-and-ink proposition. That a powder is a powder, and a liquid a liquid, is only the assertion of a vulgar error, and no real argument whatever.

I would just finish these few remarks by adding, that I believe that it is only considered fair, when any individual propounds a new theory, that he should supply a *satisfactory* explanation of phenomena which were hitherto thought to be explained by the old theory. If this be not done in a truly philosophic manner (I mean not by *mere assertion*), then the reasoning can only be considered as so much waste paper.—I am, &c.

Ultimatum.

Glasgow.

Chemical Notices from Foreign Sources.

I. ORGANIC CHEMISTRY.

New Acid Homologous with Anisic Acid.—M. Canizzaro (*Comptes-Rendus*, t. li. p. 607) heated an alcoholic solution of aniso-chlorhydric ether and cyanide of potassium until chloride of potassium was no longer precipitated. He then filtered the liquor and distilled off the greater part of the alcohol, then added water, and afterwards shook it up with ether, which dissolved the aniso-cyanhydric ether. The etherial solution being decanted, and the either evaporated, impure aniso-cyanhydric ether was left in the form of a brown oil. This, submitted, to prolonged ebullition in contact with caustic potash, was slowly decomposed, ammonia being evolved. On neutralizing the alkali with hydrochloric acid, the new acid was precipitated in an oily state. On shaking the liquor with ether and evaporating the etherial solution, a yellowish oil was obtained which, after a time, crystallised. The crystals were obtained colourless by dissolving them in carbonate of soda, filtering the solution, reprecipitating the acid, and recrystallising from boiling water. *Homo-anisic* acid thus obtained crystallises in nacreous plates, which melt between 85° and 86°. At a higher temperature the acid distills without undergoing decomposition. It is soluble in alcohol, in ether, as well as in boiling water, and but slightly in cold water. The soda salt is very soluble in water. A silver salt was obtained by precipitating the soda salt with nitrate of silver. The ultimate analysis of the silver salt agreed perfectly with the formula

$$C_9H_9AgO_3.$$

The two following series of formulas express the transformations by which benzoic alcohol becomes toluic acid, and the perfectly analogous transformations to which the author submitted anisic alcohol:—

Benzoic alcohol . .	$C_7H_7,HO = C_7H_8O$
Benzo-chlorhydric ether	$C_7H_7,Cl = C_7H_7Cl$
Benzo-cyanhydric ether	$C_7H_7CN = C_8H_7N$
Toluic acid . .	$C_7H_7,COHO = C_8H_8O_2$
Anisic alcohol . .	$C_8H_9O,HO = C_8H_{10}O_2$
Aniso-chlorhydric ether	$C_8H_9O,Cl = C_8H_9OCl$
Aniso-cyanhydric ether	$C_8H_9O,CN = C_9H_9ON$
Homo-anisic acid .	$C_8H_9O,COHO = C_9H_{10}O_3$

II. ANALYTICAL CHEMISTRY.

Estimation of Organic Matter in Water.—The action of permanganate of potassa on organic matter in water usually takes place with extreme slowness at the ordinary temperature. At a high temperature, on the contrary, ranging between 70° and 75° C., the reaction takes place rapidly, and the oxidation of the complex substances is effected in a few seconds. By operating always at a fixed temperature of 70° C., M. Emile Monnier (*Comptes-Rendus*, t. l. p. 1084) has obtained the following results:—A litre of water from the Seine, at Bercy, decomposed 6 milligrammes of pure permanganate of potassa, and when taken at Passy, 7·1 milligrammes for the same volume. The unhealthy waters of the Bièvre decomposed per litre, 58 milligrammes of permanganate; as to the water from wells, they decompose from 3 to 12 milligrammes per litre; those containing most organic matter were in the Rue St. Antoine. Distilled water of commerce reduced 1 to 3 milligrammes per litre, by reducing them with a little permanganate of potassa they are obtained perfectly free from organic matter. The permanganate of potassa itself is not decomposed until the temperature becomes about 90° C.

MISCELLANEOUS.

THE PARAFFINE PATENT CASE.

ALLEGED INFRINGEMENT OF THE PROCESS FOR OBTAINING PARAFFINE FROM COAL.

An important trial has recently taken place at Edinburgh, under a note of suspension and interdict by E. W. Binney and Co., Bathgate Chemical Works, to prevent the manufacture by the Clydesdale Chemical Company, Cambuslang, of "paraffine oil, or oil containing paraffine, or paraffine from Torbanehill coal, or Boghead coal, or from any other bituminous coal, by distilling the same, and from infringing in any other way the letters-patent granted to the pursuers." The Court was numerously attended by scientific men and other persons connected with, or interested in, the manufacture, which is extensively carried on by both Companies.

The following alternative issues were sent to the jury:—

It being admitted that, on the 7th of October, 1850, the pursuer, James Young, obtained letters-patent under the Great Seal,—

1. Whether, between the month of July, 1855, and 13th March, 1858, and during the currency of the said letters-patent, the defenders did, at their works, wrongfully, and in contrvention of the said letters-patent, use the invention described in the said letters-patent and specification? Or,

2. Whether the invention described in the said letters-patent and specification is not the original invention of the said James Young?

3. Whether the invention described in the said letters-patent and specification was known and publicly used within the United Kingdom prior to the date of the said letters-patent?

The following is a summary of the case:—The pursuer, James Young, obtained letters-patent under the Great Seal, bearing date 7th October, 1850, granting to him the exclusive privilege of using within Scotland, during fourteen years from the date of the said letters-patent, his invention of "improvements in the treatment of certain bituminous substances, and obtaining products therefrom." In compliance with the provisions contained in the said letters-patent, Mr. Young duly lodged in Chancery a specification, dated and enrolled 7th April, 1851, which contains the following statement of his invention:—"My said invention consists in treating bituminous coals in such a manner as to obtain therefrom an oil containing paraffine (which I call paraffine oil), and from which oil I obtain paraffine. The coals which I deem to be best fitted for this purpose are such as are usually called Parrot coal, Cannel coal, and gas coal, and which are much used in the manufacture of gas for the purpose of illumination, because they yield, upon distillation at a high temperature, olefiant and other illuminating gases in considerable quantity; and although some coals last described contain a large amount of earthy matters, those matters do not interfere materially with the performance of my process. To obtain paraffine oil from coals, I proceed as follows:—The coals are to be broken into small pieces of about the size of a hen's egg, or less, for the purpose of facilitating the operation. The coal is then to be put into a common gas retort, to which is attached a worm-pipe passing through a refrigerator, and kept at a temperature of 55° Fahr. by a stream of cold water. The temperature of the refrigerator should not be made too low, lest the product of the distillation should congeal and stop up the pipe; and I find that a temperature of about 55° Fahr. is sufficient. The retort, being closed in the usual manner, is then to be gradually heated up to a low red-heat, at which it is to be kept until volatile products cease to come off; care must be taken to keep the temperature of

the retort from rising above that of a low red-heat, so as to prevent as much as possible the desired products of the process being converted into permanent gas. The coke or residue may then be withdrawn from the retort, which being allowed to cool down below a visible red-heat (to prevent waste of the fresh material to be introduced), may be again charged with a quantity of coals, to be treated in like manner as I have described. The crude paraffine oil distilled from the coals will be condensed into a liquid in passing through the cold worm-pipe, from which it will fall into a vessel which must be provided to receive it. Instead of obtaining the whole of the paraffine oil by distillation or driving off, as just described, a portion of it may, in some cases, if thought desirable, be run from the retort through an opening and pipe, to be provided in the interior and lower part of the retort for that purpose after it has separated from the coal and assumed a liquid form. I prefer, however, in every case to distill or drive off the whole of the paraffine oil to be obtained from the coal. The production of the desired products from a charge of coals in a retort will be known to be finished by the liquid ceasing to run from the worm. The crude product of this process is an oil containing paraffine, which, as already stated, I call paraffine oil. This oil will sometimes, upon cooling to a temperature of about 40° Fahrenheit, deposit paraffine; other arrangements of apparatus may be used for subjecting coals to the process for obtaining paraffine oil therefrom as I have described, but I prefer to use the apparatus above mentioned, as being well known and easily managed. But in order to obtain the largest quantity of crude paraffine oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to apply the lowest temperature necessary to complete the operation." The specification then describes the process by which the crude oil thus obtained is purified, and paraffine extracted or separated therefrom, which process, however, forms no part of the invention claimed by Mr. Young. The invention claimed by Mr. Young is stated in the specification as follows:—"I claim as my invention the obtaining of paraffine oil, or an oil containing paraffine, and paraffine from bituminous coals, by treating them in manner hereinbefore described." In reference to this invention, it is averred that, at the date of the foresaid letters-patent, the said invention was new; that the said James Young was the true inventor thereof; and that the same was, and is, of great public and practical utility. On the 22nd October, 1851, Mr. Young entered into a contract of copartnery with Mr. Edward Meldrum and Mr. Edward William Binney, whereby they agreed to carry on business at Bathgate under the name of E. W. Binney and Co.; at Glasgow under the name of E. Meldrum and Co.; and at Manchester under the name of James Young and Co.; and it was further agreed that the said letters-patent, should belong to the copartnery and the partners thereof, as specified in the contract of copartnery itself. Since the date of the said letters-patent, or about that time, the pursuers have been used to make at their works at Bathgate large quantities of paraffine oil, or oil containing paraffine, and paraffine from bituminous coals, in the manner described in the specification. The coals usually employed for this purpose are that description of bituminous coals called or known as the Boghead and Torbanehill coal, which the defenders call the Torbanehill and Boghead mineral. The Torbanehill and Boghead mineral is a species of bituminous coal. That species of coal is the coal best adapted for the manufacture of paraffine oil and paraffine, and yields these products in the largest quantities, though all bituminous coals may be employed and yield a large profit. In or about 1855, the Clydesdale Chemical Company was formed, for the purpose of carrying on a joint trade or business for the manufacture of paraffine oil and paraffine, by the distillation of bituminous coals; and since that date the said Clydesdale Chemical Company (of which the defender, Mr. John Bain, is now the sole partner), have, in direct infringement of the foresaid patent belonging to the pursuers, been carrying on a very extensive manufacture of paraffine oil, or oil containing paraffine, and paraffine, by the distillation of bituminous coals, and principally of that description of bituminous coal called the Boghead coal and Torbanehill coal, and otherwise in the manner described in the foresaid specification. This manufacture has been carried on secretly by them in works at Cambuslang; and the products which they have manufactured were substantially the same as the paraffine oil and paraffine manufactured by the pursuers under Mr. Young's patent; and the process of manufacture followed by the said Clydesdale Chemical Company was substantially the same as that described in the foresaid specification, and is an infringement of the said patent. The paraffine oil and paraffine thus manufactured by the Clydesdale Chemical Company has been principally sold in the foreign markets, though also to some extent in the home markets.

The defenders, in their answers, point out that the patent granted to Mr. Young was for "improvements" in the treatment of certain bituminous mineral substances; and, while entering at great length into the processes by which paraffine was obtained from coal and other substances before the date of Mr. Young's patent, and referring to numerous scientific works published both in this country and on the Continent previous to that date, they maintain that "it was well known to chemists and scientific and practical men in Great Britain and other parts of Europe, and also in America previous to 1850, that it was by the application of a low degree of temperature that these products are obtained by distillation in greatest quantity from bituminous substances and coals, and that the higher the temperature the less of these substances, and the more gas, is obtained." The defenders conclude their statement of facts, with the following pleas in law:—1. The complainers' patent is void and invalid, in respect of uncertainty, and also in respect that the specification contains old methods of manufacture, which are not distinguished from what is alleged to be new, and are claimed together with the alleged new method. 2. Mr. Young was not the true and first inventor of the said alleged new manufacture, founded by the complainers, and therefore his patent is bad. 3. The said patent is further void and null, in respect that the said manufacture claimed by Mr. Young and the complainers, was not, at the date of his letters-patent, a new invention within this realm. 4. Even supposing Mr. Young's patent to be valid, respondents have not infringed upon the same, the manufacture carried on by them being substantially different from the manufacture, or *modus operandi*, or manner, described in his specification, and which alone he claims. 5. The mode of manufacture used by the respondents at and since the date of the note of suspension and interdict having been patented, published, and publicly used long prior to the complainers' patent, there are no grounds for interdict as against them. 6. The conclusion for interdict against the respondents manufacturing or obtaining paraffine oil, or oil containing paraffine, and paraffine from Torbanehill mineral, or from bituminous coals by distillation, is groundless and untenable. 7. Generally, in the circumstances above set forth, there are no grounds, either in point of fact or of law, on which interdict can be craved, and, therefore, the reasons of suspension and interdict ought to be repealed, with expenses.

The Lord President in summing up, began by calling the attention of the jury to the general principles and provisions of the patent laws, and directed them that a patent might properly be applied for and granted for a new method, or an improved method, of obtaining a product

formerly produced by other methods; and if the new method had the merit of producing the article more economically than was done formerly, it none the less fell under that rule. In the present case the object of the patentee appeared to be the obtaining, in merchantable and profitable quantity, of a product which had only been obtained before in small and unprofitable quantity; and the subject-matter of the patent was the novelty of the treatment used for the production of the crude oil from which paraffine is afterwards separated. Now, if it was a new discovery that the treatment of certain bituminous substances in the way described in the patentee's specification would give a useful merchantable quantity of a certain product, which had never been so obtained before by any treatment of any substance, and if it was the fact that the modes previously and then in use of treating these bituminous substances during the progress of distillation would not produce that result, but gave other products than paraffine, or gave paraffine only in very limited and unmerchantable quantities—then he thought that discovery might be made the subject of a patent, and he saw nothing on the face of the present instrument to invalidate the patent. But by novelty, it must be understood that the discovery or the process was really and substantially new—not only that the very identical thing was unknown, but that nothing was known or practised before which would obviously suggest to any practical man to do the same thing. That raised the question as to whether or not the discovery and process patented by Mr. James Young was really a novelty, and this must be determined by the evidence. The question as put in the issues was not only whether the invention described in the patent and specification was the original invention of James Young, but also whether it was known and publicly used in the United Kingdom prior to the date of Mr. Young's patent. It might have been his original invention in the sense that he had never heard of its being used by anyone else; but if it could be shown that, although he might not have heard of it, the invention was already known and publicly used within the United Kingdom, then the patent could not be maintained. The pursuer did not pretend that paraffine was unknown before his patent, or that the distillation of coal was a novelty. But the defenders went further, and not only alleged but brought evidence to show that all the elements of novelty which were said to exist in the mode of treatment of bituminous substances described by Mr. Young were known and practised before. A number of scientific publications were referred to, and the evidence of scientific men was given to show that it was known before Mr. Young's patent that paraffine could be obtained from coal by first making tar, and then from that substance making paraffine; and it was stated that that tar was just the same thing which was obtained by Mr. Young in the first and patented part of his process. It was also urged by the defenders that it was a general law—known and promulgated long before the date of Mr. Young's patent—that a larger proportion of liquids and solids and a smaller amount of gases was obtainable by the distillation of coal at low temperatures than by its distillation at high temperatures. That was a point for the jury's consideration, but he did not know whether there was anything, either in Chemistry or in any other science, which might not be placed under some general law. It did not follow, however, although the general law were known, that its application in any particular instance was also known. The patentee admitted that it was known that tar, gas, and other products could be obtained from coal; but it was not known that paraffine, in merchantable quantity, could be obtained from it—and that was his discovery. If it was known to scientific men before, as was alleged, it was very strange, he argued, that the product "paraffine in merchantable quantity" was not obtained by any of them. Scientific works and journals were appealed to, and scientific men of such eminence as Dr. Penny, Dr. Lyon Playfair, and Sir Robert Kane, stated that they had read these publications, but that their eyes had not thereby been opened to the discovery claimed by Mr. Young. On the other hand, scientific men equally eminent—Dr. Taylor, Mr. Campbell, Mr. Brande, and others—stated that they could find in these various books all that Mr. Young had claimed as his discovery. In these circumstances the jury must look to the publications referred to themselves, and they must try—which was a very difficult matter—to put themselves in the position of having read these journals before Mr. Young's discovery or process was known to them. The Lord President then proceeded to comment on various portions of the evidence, and concluded by directing the jury to return a verdict in accordance with the principles of the patent laws which he had explained at the outset of his observations.

The jury then retired, and after an absence of about half-an-hour, returned a verdict for the pursuers on all the issues.

Adulteration of Food Act.—This Act was adopted by the Corporation of Birmingham at their last sitting.

Electro-Zincing by MM. Person and Sire.—In a hundred parts of water dissolve ten parts of alum, and one of oxide of zinc: this zinc-bath should be kept at a temperature of 15° C. The pieces of metal which are required to be coated with zinc being previously well cleaned, are arranged so as to form the negative pole of a battery, and for the positive pole one or more pieces of zinc are introduced, according to the shape of the article to be zinced, and having as near as possible the same amount of surface. Contact with the battery being made, by the current from one pair of plates, the dimensions of which should vary according to the surface to be coated, the precipitation of zinc proceeds as easily as that of copper in the ordinary electrotypic process, the deposit taking place indifferently on any metal,—on platinum as well as on copper or iron. When copper, coated with zinc, is heated, there is produced a coating of brass; this transformation is likely to receive many applications. The elevation of temperature of the zinced iron augments the adhesion of the surface of zinc. MM. Person and Sire state that the thickness of the layer which is deposited increases in proportion to the time occupied in the deposition; that the reduced zinc has all the properties of the purest metal; and that it completely prevents the oxydation of the object which it coats.

Coloured Liquids.—The gradual decoloration of coloured alcohol by the influence of light and the precipitation consequent on the chemical change produced, is of importance to the druggist anxious for the showy appearance of his windows. The following remarks will therefore be read with interest and benefit:—Solutions of various salts or metals in hydrochloric acid are, some of them, of very great intensity and beauty. Thus, a yellow liquid is obtained by dissolving 3 parts of perchloride of iron, or hydrated peroxide in 100 of hydrochloric acid: the colour may be heightened by adding some hydrated oxide. Various colours are produced with the solution of carbonate of cobalt in hydrochloric acid. The salt of cobalt used must be pure, especially free from iron or nickel, which would prevent the formation of the blue and red shade. The green cobalt colour is obtained by dissolving 3 parts of the protocarbonate in 100 parts of the acid, and filtering. By the addition of a few drops of the above yellow liquid the colour is deepened, and loses the bluish tinge. A blue colour is prepared by dissolving six parts of the protocarbonate of cobalt in 100 parts of the acid, and boiling for about two minutes to remove the carbonic acid or chlorine held in solution. Neither of the above two colours should be diluted with water, as this

would change them to red. The violet colour is obtained by dissolving 34 parts of the protocarbonate of cobalt in 100 parts of the acid, mixed with 5 of water, and boiling before filtering. A very fine red liquid is obtained by dissolving 45 parts of the protocarbonate of cobalt in 100 parts of the acid, diluting with 45 parts of water, and boiling. All the cobalt colours change by heating the solutions, which gives them more or less a blue tinge; but, on cooling, this gives way to the colour intended. The solution of carbonate of chromium in hydrochloric acid evaporated until it becomes solid on cooling, and dissolved in alcohol in the proportion of 25 parts of the salt and 100 of the spirit (to which are added 5 parts of acid,) furnishes a fine deep green. Four parts of crystallized acetate of copper, dissolved in a mixture of 50 parts of ammonia, and 50 of alcohol, give a durable blue.

Homogenesis of Forces.—There is no question occupying more attention among the highest order of intellects than that of the identity of the several invisible forces of Nature. The relations of magnetism, electricity, chemical affinity, heat and light, are certainly very close and very complicated. Each one of these forces is capable of producing either or all of the others. They may also all generate mechanical power, and mechanical power, on the other hand, may generate all of these forces. Perhaps as good an illustration of this as any is to be found in the electric light. First, the mechanical power of a *steam-engine* turns a wheel which carries a number of permanent *magnets* at its periphery; these magnets, as they are carried past the ends of soft iron cores which have insulated wires wound around them in helical form, cause waves of *electricity* to flash through the helical wires; the electricity, darting along from drop to drop of an exceedingly slender stream of flowing mercury, produces an intense *light*; it also generates *heat*, by which the mercury is evaporated. But whence comes the mechanical power of the steam-engine? That results from the expansion of steam caused by heat, and the heat is produced by the combustion of fuel, which is its chemical combination with oxygen; in other words, *chemical affinity*. If we replace the steam-engine by a water-wheel, we have the several forces produced by *gravitation*. It is to be remarked, however, that gravitation cannot be generated, in its turn, by any of the other natural forces or by mechanical power. From these several facts, and others of the same kind, the grand and simple idea has been suggested that all the forces in Nature are the same thing; merely *matter in motion*. This suggestion implies that all the countless phenomena of chemical combination,—all the appearances produced by light, its endless variety of colour and shade, its refraction, reflection, and polarisation, with the miraculous revelations which these have given us through the telescope and the microscope,—the tremendous power of heat, with its contractions, expansions, freezings, and evaporations,—all the swift and subtle operations of electricity in the galvanic battery, the lightning-rod and the telegraph, and, finally, the growth and decay of plants and animals, the action of the muscles, the stomach, the lungs, the nerves,—in short, all the phenomena of the universe,—are produced merely by changes in either the velocity or the direction of the motions of matter. Such is the doctrine of the homogenesis of forces. A sublime and comprehensive theory, whether true or false! A few scientific men have committed themselves to it fully; but most able philosophers regard it as yet as unproved, though it seems to us that there is a general leaning towards it,—a prevalent feeling that it will turn out to be true. As the relations of the natural forces to each other caused the conception of the theory, so the promulgation of the theory has led to a very close study of these relations; and the field is as rich in curious and wonderful facts as any that has ever been explored by the student of Nature.

ANSWERS TO CORRESPONDENTS.

**** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Press of matter obliges us to defer the conclusion of Professor Austed's Lecture on the "Antiquity of the Human Race," till next week.

A Country Subscriber.—As far as we can judge by the appearance of the writing, the three specimens of ink would be good enough for all ordinary purposes, provided they could be supplied at a low price, and would stand the action of Chemical agents better than the ordinary iron ink. No. 1 is almost too brown at present to be much used unless it had the recommendation of cheapness. Nos. 2. and 3 look very good. Send us some samples of the inks themselves, and we will try them.

A Subscriber to the Chemical News.—1. See Knapp's "Technology," published by Baillière and Co., Regent Street. 2. Williams' "Chemical Manipulations," published by Van Voorst, price 15*s.*"

Enquirer.—To become a Member of the Chemical Society, you must be proposed and balloted for. The subscription is 2*l.* per annum, and 2*l.* entrance fee. For information respecting the Royal Institution, apply to the Secretary.

A. Adriani.—Received with thanks, but too late for the present number. We shall be very pleased to have the continuation.

J. Horsley.—Thanks for the information. We will with pleasure do as you wish, if asked.

A Novice.—Sulphuretted hydrogen is best obtained by the action of dilute sulphuric acid on sulphide of iron. To determine the amount of iron in red iron ore, dissolve in hydrochloric acid, and determine the iron by means of a standard solution of permanganate of potassa in the manner recommended in works on analysis. We cannot occupy space in giving the details of the method, but would recommend you to consult the new edition of Fresenius's "Quantitative Analysis," just published.

J. A. D.—With many thanks for the offered articles, we must beg to decline giving them insertion.

Books Received:—"Chemistry," by George Wilson, M.D., F.R.S.E. New Edition, being one of the volumes of Chambers's Educational Course.—"Jahresbericht über die Fortschritte der Chemie," für 1859. Giessen: 1860.

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THE CHEMICAL NEWS.

VOL. II. No. 51.—November 24, 1860.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Analysis of Carbon Employed in the Manufacture of Gunpowder, by M. Le Comte PAUL DE SAINT-ROBERT.

OF the three constituents of gunpowder, two—saltpetre and sulphur—are always employed in the same state of almost absolute purity; it is otherwise with the third—charcoal—which consists of carbon, hydrogen, oxygen, nitrogen, and ash, varying according to the method of carbonisation and the kind of wood employed. The composition of the powder having to be determined by the nature of the charcoal, it is desirable to possess an unfailing and reliable analytical process. M. de Saint-Robert mentions one which he has found to succeed well. It is not exactly requisite to know the elementary composition of the charcoal, but the quantity of oxygen required to burn it, or to convert its carbon and oxygen into carbonic acid and water. Given, in fact, this quantity of oxygen, it is possible to deduce from it the proportion of nitrate of potash necessary to yield it; and the portion of potassium contained in this nitrate will give the sulphur necessary to transform it into monosulphide. M. de Saint-Robert has established, by very simple considerations and calculations, the fact that the composition of powder, for a sample of charcoal a gramme of which requires n grammes of oxygen to burn it up completely, is:—Saltpetre, 51; charcoal, $\frac{24}{n}$; sulphur, 8. The only quantity to determine, then, is n. This is arrived at by M. Berthier's method, which consists in mixing the charcoal to be experimented upon with about 50 times its weight of litharge, protoxide of lead, PbO, and in exposing it to heat in a crucible; calling p the reduced lead then 108, the equivalent of lead is to 8, the equivalent of oxygen, as p is to n; and, consequently, $n = \frac{1}{15}\ p$. Here is the process:—Commence by driving the water from the charcoal to be analysed by heating it several times to a temperature a little above that of boiling water; that accomplished, pulverise the charcoal as fine as possible; take a given weight of it, and mix it with about 30 times its weight of powdered litharge; place the mixture carefully at the bottom of an earthen crucible, and put over it another equal quantity of powdered litharge; the crucible should be half-filled at most; place the crucible on a little baked-clay cylinder, serving to raise it from the bottom of the furnace; place the whole in a furnace already heated, and filled with well-kindled charcoal; put the cover on the crucible and heat gradually. The mass softens, boils, and often swells up. When the fusion is completed, cover the crucible with charcoal and enliven the fire for about ten minutes, that the lead of the litharge which is set free may unite in a single button. Take the crucible from the fire and let it cool in the air; then break it and withdraw the lump of lead and weigh it; the button adheres neither to the crucible nor the scoria, and a blow from a hammer is sufficient to detach it. It is sometimes livid, foliated, and somewhat ductile; this is when it contains a small quantity of litharge, which sensibly augments its weight. These indications show that the experiment has been conducted too rapidly, and must be performed again. The experiment should generally be repeated at least twice, and the results cannot be relied on except when they differ only from $\frac{1}{16}$ to $\frac{2}{16}$ of a gramme. This method of analysis applied to four kinds of wood charcoal,—hemp stalk, white osier, white willow, and hazel,—yielded by distillation in cylinders from 25 to 30 per cent.; or, by carbonisation in a furnace, gave exactly the same results as the elementary analysis after Liebig's method. For the charcoals resulting from distillation at 25 per cent., the mean of the quotient of 24 by n, or the proportion of oxygen required to burn a gramme of charcoal, was 10·25. If to this sum is added 2 per cent. for humidity, we have 10·45, which may be considered as the value of this kind of black charcoal. The proportion necessary for gunpowder is as follows:—Saltpetre, 51 or 73·4 per cent.; charcoal, 10·45 or 15·1 per cent.; sulphur, 8 or 11·5 per cent. Messrs. Bunsen and Chiskhoff have found that the residue from the decomposition of gunpowder was composed for the most part of sulphate and carbonate of potash, and not of sulphide of potassium, as is stated in most of the Treatises on Artillery and Chemistry. M. de Saint-Robert, it seems to us, proves incontestably that if, instead of testing an exceptional and hyper-oxygenated gunpowder, skilful chemists had operated upon the ordinary gunpowders used in warfare, they would probably have discovered that this residue of combustion was composed of monosulphide of potassium, and not of sulphate and carbonate of potash.

Researches on the Juices of the "Ficus Elastica" and the "Isonandra Gutta" (India Rubber and Gutta Percha), by A. ADRIANI, *M.D., Math. Mag. Phil. Nat. Dr. F.R.N.I.E., &c. &c.*

FULLY ten years ago I published, at Utrecht, in the Dutch language, a pamphlet containing the results of experiments on Caoutchouc (India-rubber) and Gutta Percha, which have almost escaped notice; and, although I do not wish to overrate my own work, I think an abstract of the more interesting parts will be agreeable to many of the readers of the CHEMICAL NEWS. In the first place, I had a very good opportunity of making a set of microscopico-chemical experiments upon the fresh milky juice of the *Ficus elastica*, which tree, 2·25 mètres in height, after I had finished to bleed it, so to say, has been brought over to the Botanical Garden of Utrecht University, where it has remained growing in vigorous health. As general results of these experiments, I found that the quantity of solid matter contained in the milky juice decreases, according to its being collected

from incisions made in the higher and, consequently, younger parts of the plant.

At a height of 30 centimètres from the surface of the soil in which the plant was placed, I found that 0·183 grammes of juice leave, on cautious evaporation in vacuo over sulphuric acid, 0·046 grammes solid dry matter, equal to 25·15 per cent.

At 174 centimètres height, 0·395 grammes of juice leave 0·095 grammes, equal to 24·05 per cent.

At 210 centimètres height, 0,143 grammes juice leave 0·030 grammes, equal to 20·98 per cent.

And, finally, at the very top, 0·825 grammes of juice left 0·145 grammes, equal to 17·70 per cent. dry, solid matter.

The juice was collected so as to prevent evaporation during the time of its being collected. The figures prove that, as stated above, the juice in the older parts of the plant does contain more solid matter than the younger. This was evident also from the far stronger white colour possessed by the juice obtained from incisions made in the lower part of the plant as compared with that obtained from the higher parts, which juice, even at first sight, appeared more watery.

The milky juice, as obtained quite fresh from the older as well as young parts of the plant, distinctly reddens blue-coloured litmus paper; it must, consequently, contain either a free acid or an acid salt.

The microscopical and micro-chemical experiments gave the following results :—The juice is seen to consist of a clear liquid, wherein are seen floating a large number of quite spherical globules, which strongly refract light, and present, consequently, black circumferences by transmitted light, while they reflect the light with a white colour the size of the globules. I found from 0·8 to 5·1 micromillimètres[1] for the juice taken from the lower part of the plant; the average of 10 determinations gave 2·3 micromillimètres; the size of the globules of the juice taken from the top of the plant was varying from 0·5 to 5·1 micromillimètres; average of 10 determinations, 2·0 micromillimètres. Addition of water does not give rise to any change in the globules. Addition of an excess of alcohol[2] to a drop of the juice does not change the globules, but after a few moments there appear a great many small crystals, or, rather, nuclei of crystals, which grow larger and larger, and form small groups of needle-shaped crystals. When ether is added to a portion of the fresh milky juice, collected on a watch-glass, this fluid causes the globules to adhere together, and to form an amorphous mass, the same crystals already alluded to make their appearance, forming, however, larger groups. Addition of concentrated acetic acid causes the globules to run together, and so as to augment in size to almost double their primitive size, but without alteration of shape. I measured some where the size was 10·5 micromillimètres, equal to $\frac{1}{2456}$ English inch.

Pure concentrated nitric acid has no effect on the globules, but produces a small membraneous precipitate in the fluid surrounding the globules. This precipitate is white, and does not undergo any change by addition of ammonia. Hydrochloric acid produces no effect when added to the milky juice, neither does it affect the globules.

The addition to the fresh milky juice of pure concentrated sulphuric acid changes the total mass of the juice to a brown-coloured, tough, viscous mass, which, after having been divided through water, appears to consist of brown semi-fluid corpuscles, of round or oval shape, in which are seen smaller corpuscles, whose shape agrees with that of the globules as seen before addition of sulphuric acid. Solution of ammonia, when added, does not effect any change in the globules, but induces a slight yellow tinge in the surrounding liquid. Solution of caustic potassa when added to the milky juice acts quite similarly to ammonia.

Tincture of iodine has the effect of changing the globules entirely. They first get brown, then run together and form a tough viscous mass, which may, by moving about the small square piece of glass which covers the drop,[3] be stretched out into long, fibrous threads. The effect of the addition of bromine is similar to that described for iodine, but the action is more slow.

From these reactions the following conclusions may be drawn :—

1. The globules are either in a whole, or, at least to a great extent, made up of caoutchouc. This is proved by their unchangeableness in contact with many of the strongest chemical re-agents, and by their agglutination upon the addition of ether,—in which fluid, if free from alcohol and water, they proved to be moreover entirely soluble,—also by the changes they (the globules) undergo if brought into contact with iodine and bromine, whereby true combinations with caoutchouc are produced.

2. In the clear liquid is dissolved a pretty large quantity of a substance insoluble in alcohol and ether, which substance is precipitated from the clear liquid, on addition of ether or alcohol, in a crystalline state.

3. The clear liquid (*i.e.* that in which the globules of caoutchouc float) contains, in a state of solution, another substance which is precipitable by nitric acid, yielding a white coloured precipitate, but proved to be neither albumen nor other protein compound: it is likely to be the same substance which assumes a yellow colour on addition of alkalies. In order to come to a more complete knowledge about the nature of the substances alluded to, and present in the freshly-taken milky juice of the *Ficus elastica*, a very small quantity thereof[4] was left to spontaneous evaporation, to dryness in a warm room, but free from dust. In the dry state the globules aforementioned are no more seen, they have run together, and form a kind of membrane as it were. This membranous mass is entirely soluble in pure ether (free from alcohol and water); there remains behind the crystalline masses already alluded to. On igniting cautiously a portion of the dried (spontaneously) milky juice, the caoutchouc is rapidly consumed, the crystals are charred, but become white again after sufficient heating without losing their shape, but with the loss of their transparency.

The ash of the crystals is soluble with effervescence in dilute nitric and hydrochloric acids, and nothing insoluble in these acids remains behind; no silica was detected in the ash; it is, therefore, to be presumed that the crystals already alluded to are made up of an organic acid combined with an incombustible base. The solution

[1] This measure, adopted by the Professor of Microscopical Science and Histology at Utrecht, Dr. Starting, is equal to one millimètre divided into 1000 parts. 1·0 micromillimètre is therefore 1-1000th of a millimètre, equal to 0·000039 English inch, or to 1-25500th part of an English inch. The above measures, therefore, viz. 0·8 to 5·1 micromillimètre are respectively equal to 1-50800th and 1-4980th English inch, 2·3 micromillimètre = 1-11050th of an English inch.

[2] Specific gravity, 0·835.

[3] All reactions described were performed with minute quantities, and the effects produced observed by microscopes with divers magnifying powers.

[4] Only a few drops, for, be it remembered, the whole analysis here described was done assisted with the aid of the microscope.

of the ash in hydrochloric acid was evaporated to dryness, and the remaining saline mass re-dissolved by a few drops of water; the following re-agents produce in small portions of the solution of the ash the effects thereby mentioned.

(To be continued.)

On the Basic Carbonates of Copper, *by* Frederick Field.[1]

The carbonates of copper have frequently attracted the attention of chemists. The well-known bluish-green precipitate, obtained by adding an equivalent proportion of a soluble salt of copper to carbonate of potassa or soda, has for its formula $2CuO, CO_2, 2HO$, which, on heating in the supernatant liquid, becomes granular and of a pure green colour, losing one atom of water. This compound has exactly the composition of the native malachite, as well as the green crystalline carbonate found abundantly in South America. The sesquibasic carbonate of copper, $3CuO, 2CO_2$, known to mineralogists as azurite, has also been formed artificially, although I am not aware of the method employed for its preparation. M. Favre (*Journal de Pharmacie*, April, 1844) obtained another carbonate of the green tint of acetate of copper, having the formula $3CuO, 2HO, CO_2$, in which one equivalent of water has replaced one equivalent of carbonic acid in azurite:—

Azurite . .	$3CuO, 2CO_2, HO$
Favre's compound	$3CuO, 2HO, CO_2$.

The following experiments were commenced with the hope of obtaining a neutral carbonate of copper (CuO, CO_2), such a compound at present being only known in the dark-brown mineral, mysorine; and, although unsuccessful in forming this body, results were elicited of a character sufficiently interesting, I hope, to warrant the attention of the Society.

On adding sulphate of copper to a great excess of solution of sesquicarbonate of soda, no precipitate is obtained until a considerable quantity of the cupreous salt has been introduced. Even then, on gently warming, the small precipitate of carbonate of copper is dissolved, forming a bright blue solution. When this liquid is boiled for some time a green granular precipitate is obtained, the supernatant liquid still holding copper in solution with great tenacity, and maintaining its clear blue colour. If the ebullition has not been continued for more than half-an-hour, on filtering the liquid from the precipitate the former is found to be capable of dissolving a further quantity of copper, which is precipitated as a green powder, similar to the last. After very protracted ebullition, however, the filtrate from this last precipitate yields, on the introduction of sulphate of copper, not a green powder, but one of a dense black colour. In order to give some idea of the quantity of copper dissolved by a solution of sesquicarbonate of soda, the following experiments were performed:—

1,000 grains (by measure) of a cold saturated solution of sesquicarbonate of soda were placed in a flask, and a standard solution of sulphate of copper added from a burette until a slight permanent precipitate was obtained. The quantity of sulphate thus added was 22·109 grains, equal to 5·660 metallic copper. The clear, dark-blue solution was boiled for about half-an-hour, when a granular precipitate was deposited of a pure green colour. After further ebullition, with occasional addition of water, the precipitate was thrown upon a filter and well washed. It was found on analysis to contain 5·03 of copper, leaving only 0·63 metal in the filtrate, which, even though somewhat largely diluted by the washings from the filter, still retained a moderately dark-blue colour. Sulphate of copper was added to this, as before, but a smaller quantity was required to form a permanent precipitate, doubtless owing to the partial decomposition the alkaline fluid had already experienced. After the addition of 13·79 grains of the cupreous salt, equal to 3·537 copper, a precipitate was effected. The solution was boiled for an hour, when a dense black powder precipitated. This was filtered off, and found to contain 3·612 copper. In order to correct the results, the metal was also estimated in the filtrate. It proved to be 0·48, agreeing very nearly with the calculated quantity. Thus, 5·660 copper were originally added, and 5·03 found in the precipitate after boiling; 0·630 should, therefore, have been in the filtrate, and to this 3·537 copper were added, making together 4·167. After the second ebullition, 3·612 copper were thrown down, which, deducted from 4·167, leaves 0·555.

Composition of the Green Precipitate.—After thorough washing, the green compound was dried on a water-bath until it ceased to lose in weight, and the copper and carbonic acid determined, the water was estimated as loss,

	1	2
Copper . .	57·46	57·21
Carbonic acid .	19·45	19·31

and is identical in composition with the ordinary green dicarbonate and malachite, as the following numbers show:—

	Found.	Calculated.
CuO . . .	71·81	72.06
CO_2 . . .	19·45	19·82
HO (as loss) .	8·74	8·12
	100.00	100.00

For the sake of comparison, a fine specimen of pure malachite, from the West Coast of Africa, and some beautiful crystals of native dicarbonate of copper from Chilli were also analysed.

	Malachite.	Crystals.
CuO . . .	71·74	71·69
CO_2 . . .	19·68	19·80
HO . . .	8·58	8·51
	100·00	100.00

or $2\,CuO, CO_2HO$.

Composition of the Black Precipitate.—This compound, after boiling with the strongly alkaline liquid for a considerable time, was washed and dried on a water-bath. The following are the results of two analyses:—

1		2	
CuO .	91·42	CuO .	91·39
CO_2 .	8·44	CO_2 .	8·51

and apparently consisted of 4 equivalents of oxide combined with one of dicarbonate of copper, or, which is the same thing, 6 of oxide of copper and 1 of carbonic acid, as the following numbers will show:—

Found.		Calculated.	
CuO .	91·405	CuO .	91·60
CO_2 .	8·475	CO_2 .	8·40.

Very long-protracted boiling of the alkaline liquid was necessary to convert this compound into oxide of copper,—so much so as at one time to induce me to believe that it could not be decomposed by this means. After several hours' ebullition it had the same constitution, but ulti-

[1] Read before the Chemical Society, November 15th, 1860.

mately was completely resolved into carbonic acid and oxide of copper. If, however, it be thoroughly washed from the alkaline carbonate, and suspended in pure boiling water, it is decomposed in a few minutes. This fact led me to investigate more fully the action of liquids at a high temperature upon the ordinary dicarbonate of copper, especially as some chemists have asserted that this compound is never completely decomposed by their action, however prolonged. When powdered malachite is introduced into boiling water the mineral blackens in a few minutes, and, after half-an-hour's brisk ebullition, is entirely converted into black oxide. Artificially-prepared dicarbonate suffers the same reaction. When equivalent proportions of sulphate of copper and carbonate of soda are dissolved in water the ultimate result is the same, although much retarded by the sulphate of soda in solution. I could obtain no decomposition of either the mineral or the artificial compound in a boiling solution of chloride of sodium. Of the action of neutral carbonate of soda I shall have to speak more fully presently.

When sulphate of copper is gradually added to a strong solution of carbonate of soda an immediate blue precipitate occurs on the addition of the first few drops, unaccompanied by effervescence, and by the further introduction of the copper salt no more precipitate takes place, but a dark-blue solution is formed. When this is heated it immediately darkens, owing to decomposition and the formation of a black powder. The temperature of 212° is not necessary to effect this change; it begins at about 140° F., and seems to be complete before the liquid enters into ebullition. The addition of sulphate of copper to the supernatant carbonate of soda causes a bright, temporary blue colour, which is almost instantaneously changed into the black. After obtaining a sufficient quantity of this substance, and boiling it in the liquid from which it was precipitated for some time, it was washed, dried, and subjected to analysis. The results are as follows:—

	1	2
CuO . . .	91·49	91·52
CO_2 . . .	8·38	8·41

proving it to have the same composition as the one mentioned above,—viz., $4CuO, 2CuOCO_2$.

This highly basic carbonate can be boiled with carbonate of soda for many hours without decomposition; suspended in pure boiling water it is speedily decomposed.

Action of Carbonate of Soda upon Dicarbonate of Copper.—When a solution of carbonate of soda is heated, even only to the temperature of 120° F., and powdered malachite or artificial dicarbonate introduced, decomposition quickly takes place, as is shown by the darkening of the compounds. The action is very striking if the solution be saturated and boiling. Both substances (mineral or artificial) are changed instantaneously from light-green to black, and, if a large flask be employed, and the contained liquid agitated as the powder is dropped in, it forms an instructive class-experiment. An evolution of carbonic acid always accompanies the reaction. The compound produced has invariably the same composition as those previously mentioned if the liquid is boiled for a few minutes. In order to obtain this basic carbonate with certainty, it is only necessary to add sulphate of copper in solution, or dicarbonate of the same metal to a great excess of solution of carbonate of soda at a boiling temperature, and, after the heat has been maintained for half-an-hour, to separate the precipitate by filtration. It necessary to boil for some little time, as it was found that the compound which subsided after the immediate addition of the copper salt contained variable proportions of oxide and dicarbonate. A few minutes' boiling, however, yields the compound $4CuO, 2CuOCO_2$.

It may further be remarked that when dicarbonate of copper, either artificially prepared or as malachite, is boiled with a solution of sesquicarbonate of soda, it is dissolved and a blue solution is formed, which, after long ebullition, is not decomposed. Sesquicarbonate of soda containing carbonate of copper in solution appearing to resist the action of heat far more strongly than it does in the absence of the latter metal.[2]

It may not be out of place to remark upon the solubility of sulphite of copper in carbonate of soda, and especially in the sesqui or bicarbonate of that alkali. When sulphate of copper is added to a mixed solution of sesquicarbonate and sulphite of soda no precipitate is effected. In a paper upon the various methods for the determination of copper, published in an early Number of the Chemical News, I mentioned this fact. M. Terreil informs us (*Comtes-Rendus*, February, 1858) that the copper salts are completely reduced to the lower oxides by alkaline sulphites, but only in the presence of ammonia. This appears to be incorrect. An easy and safe method of deoxidation consists in adding a mixture of about equal parts of sesquicarbonate and sulphite of soda to a hot solution of a proto-salt of copper. After heating for some little time, the introduction of a slight excess of hydrochloric acid produces a solution which is perfectly colourless, and gives with potash the clear orange precipitate of suboxide of copper, and with ammonia no blue shade, if the air be carefully excluded.

On the Estimation of Nitrogen in Manures and other substances, by J. Walker.

This process is based on the fact that NH_4O + ZnCl in solution forms ZnO + NH_4Cl.

The sample is mixed with soda-lime, put into a combustion-tube and decomposed in the ordinary way, but instead of passing the resulting gases into HCl or SO_3 as recommended by Fresenius, they are at once passed into a dilute solution of ZnCl. It is obvious that one equivalent of NH_3 will form one equivalent of ZnO, which only requires to be filtered, washed, dried, and ignited. From the weight of the ignited precipitate the quantity of N or NH_3 is easily calculated, 40 of ZnO being equal to 14 of N, or 17 of NH_3. This process has been practised by me for the last two years, and gives most accurate results, and I can with perfect confidence recommend it.

It may occur to some chemists that solutions of other metallic salts will answer the same purpose, but I prefer zinc to a number of others for the following reasons: Solutions of iron are difficult to preserve without undergoing decomposition. The precipitate formed with proto-salts of manganese is partially altered into peroxide upon ignition. Solutions of cobalt or nickel may answer, but they are not so easily obtained in a pure state as zinc. Oxide of copper is not perfectly precipitated by ammonia. A solution of zinc can easily be

[2] When pulverised malachite is placed in a solution of bicarbonate of soda, and the latter boiled for more than three hours and entirely converted into the neutral salt ($NaOCO_2$) the mineral, strangely enough, does not seem to be decomposed, much of it remaining dissolved, forming the blue solution so frequently spoken of in this paper. If solution of sulphate of copper be dropped in, however, a black precipitate is speedily produced.—F. F.

prepared free from any impurities; it will keep for any length of time without alteration, and whether it be NH_4O, or NH_4O,CO_2, that is passed into the solution, the precipitate is ultimately obtained upon ignition as ZnO.

I prefer to use the solution dilute, specific gravity 1·025, and to take about ten fluid ounces for each analysis; for washing the precipitate I prefer to use water at about 150° F.

Crawford Street Chemical Works, Glasgow.

On a New Alkali-Metal, by MM. Bunsen *and* Kirchhoff.

In a recent number of the *Philosophical Magazine* there is given an account of some researches by MM. Bunsen and Kirchhoff on the effect produced by various metals on the spectrum of a flame in which their chlorides are volatilised. That part of their investigation which is more particularly interesting consists of a method of photochemical analysis of exquisite delicacy, which the authors have specially studied in relation to the alkali-metals.

These metals have been employed in the form of chlorides, which have been purified with the greatest care. When these are introduced into a jet of flame they volatilise to a greater or less extent, and then communicate to the flame the special character above alluded to, and which is observable when the spectrum produced by the flame is examined by a sufficient magnifying power.

The above-named memoir is accompanied by a coloured plate which illustrates the spectra of the alkali-metals with their characteristic rays. These rays are the more visible in proportion as the flame is less luminous and its temperature higher. The ordinary Bunsen gas-burner answers admirably for these experiments. The rays shown by the chlorides of potassium, sodium, and lithium are perfectly well-defined; those of barium, strontium, and calcium are more complicated, and require a somewhat experienced eye for their identification. They are, however, quite distinct enough to be easily recognised, even when salts of these metals are mixed together; for the great advantage of this method of analysis is, that foreign matters have no influence on the results, the authors being able to detect with certainty the different elements in a mixture containing the tenth of a milligramme of the metals mentioned above. Sodium, with its yellow ray, first appears; after that the well-defined red ray of lithium; next is seen the paler rays indicating potassium; and, after these rays have disappeared, they are replaced by those of calcium and strontium, which remain visible for some time. The absence of one or other of these sets of rays shows the absence of the corresponding metals.

We are, then, by this method placed in possession of an analytical process of the most extraordinary delicacy. The researches of our authors prove that this sensibility almost approaches the infinite, the eye being able, by its means, to recognise the presence of the $\frac{1}{0000000}$ part of a milligramme of chloride of sodium. It must not, therefore, be a matter of surprise to find sodium distributed almost everywhere, especially in the atmosphere, in which is almost always a sufficient quantity to show the sodium ray. The same may be said in great measure of lithium. In a room of a capacity of about 60 cubic mètres was exploded a mixture of sugar-of-milk and chlorate of potassa, containing 9 milligrammes of carbonate of lithia. The lamp, being placed at some distance off, became quickly coloured, so that the red ray could be distinctly visible in the spectrum. The authors estimated that this sensibility reached the nine-millionth part of the amount taken.

After this it must not be a matter of surprise to find that lithium is one of the widest-spread elements. The water of the Atlantic was found to contain it. It was also found in the ashes of plants grown on a granite soil, in the vine, in tobacco, and also in milk and in human blood. In the mother-liquors of tartaric acid manufactories, the lithia is found to be so concentrated as to be worth commercial extraction; and the same may be said of certain mother-liquors of saline springs.

With so delicate a reaction as the one just described, of an almost infinite sensibility, and applicable to all metals, the presence of elements, existing in so small quantities as to entirely escape ordinary analysis, may be rendered visible. Many observations tended to this point, and MM. Bunsen and Kirchhoff now announce definitely (*Annal. der Physik und Chemie*) that they have discovered a new alkali-metal, the fourth member of the group of potassium, sodium, and lithium. At present they have only found it in very small quantities in the mineral water of Kreuznach, in the saline water of Dureckeim, and in one of the sources of the Bade—the Umgemach.

The chloride of the new metal differs from those of sodium and lithium by the yellow precipitate which it produces in the presence of bichloride of platinum. It is distinguished from potassium by its nitrate being soluble in alcohol. Introduced into a flame, and examined with a prism, the vapours of the new chloride show a very interesting spectrum, consisting of two blue lines, one of which, the fainter, almost corresponds with the blue of strontium; the other, also a well-defined blue line, is situated a little further towards the violet extremity of the spectrum, and rivals the lithium line in brightness and distinctness of outline.

TECHNICAL CHEMISTRY.

On the Preparation of Artificial Colouring Matters with the Products extracted from Coal Tar, by M. E. Kopp.

(*Continued from page* 222.)

There is a second aniline compound in which two equivalents of hydrogen are replaced by two equivalents of nitrous acid, dinitraniline = $C_{12}H_52(NO_4)N$. By the prolonged action of sulphuretted hydrogen and ammonia on nitraniline and dinitraniline two new bases are produced,—*azophenylamine* and *nitrazophenylamine*. The following equations express the re-actions which take place:—

$$\underset{\text{Nitraniline.}}{C_{12}H_6N_2O_4} + 6HS = \underset{\text{Azophenylamine.}}{C_{12}H_8N_2} + 4HO + 6S$$

$$\underset{\text{Dinitraniline.}}{C_{12}H_5N_3O8} + 6HS = \underset{\text{Nitrazophenylamine.}}{C_{12}H_7N_3O_4} + 4HO + 6S$$

The second of these bases, nitrazophenylamine, merits some attention, inasmuch as it offers some resemblance to the coloured derivatives of aniline. It is prepared in the following manner:[1]—Dinitraniline is boiled for two hours with a great excess of sulphide of ammonium. The liquid soon becomes dark red; the yellow crystals

[1] Gerhardt, *Chimie Organ.*, iii. p. 105; Gmelin's "Handbook," xi. p. 294.

of dinitraniline disappear, and are succeeded by a network of delicate needles, of a deep red colour, the quantity of which is much increased on cooling the liquid after the reaction has terminated. Oxalic and hydrochloric acids dissolve the nitrazophenylamine, leaving the precipitated sulphur, and also a secondary crystallised product of a dirty green colour. The base may be obtained pure by precipitating a boiling oxalic or hydrochloric solution with ammonia and re-crystallising two or three times from a solution in hot alcohol. In this way nitrazophenylamine is obtained in long slender needles, united in groups, having a clear red colour when dry, and showing a golden iridescence. Water, alcohol, and ether easily dissolve it, and the concentrated solutions are of a deep red colour. It melts at a high temperature, and the greater part is volatilised apparently without alteration. Heated suddenly, it slightly explodes, leaving a carbonaceous residue.

The salts of nitrazophenylamine are very beautiful compounds, characterised by a dichroism which causes a peculiar iridescence in reflected light. All the salts must be crystallised in the presence of an excess of acid, since both water and alcohol decompose the neutral salts.

Fuchsine prepared by chloride of tin, according to the process of MM. Renard and Franc, appears to be the hydrochlorate of a base, the properties of which greatly resemble those of nitrazophenylamine. The crystallised salts show the same coloured reflections, and are decomposed (in part at least) by water and alcohol, the solutions being of a deep red colour.

We now proceed to notice the processes for the preparation of colouring matters by means of aniline, and the method of employing them for dyeing fabrics and yarns.

The first on the list is that of Mr. Perkin, for the preparation of aniline, violet or mauve. A cold solution of sulphate of aniline (rough aniline is used) and a cold solution of bichromate of potash are mixed together and left for ten or twelve hours. An abundant deposit of a black powder is thus obtained, which is separated, well washed with water, and, lastly, dried at 212°. The dried substance is then digested several times with naphtha or commercial benzole, which dissolves a brown tarry or resinous substance, contaminating the colouring matter in the deposit. The residue insoluble in the naphtha is dried again, and then digested with wood spirit or alcohol, or any other liquid able to dissolve the colouring matter. This clear solution is decanted and distilled to recover the solvent. The residue of the distillation is aniline, or aniline violet.

Mr. Perkin gives the following directions for dyeing with aniline:—To dye a lilac or purple, an alcoholic solution of the colouring matter is added to a boiling dilute solution of oxalic and tartaric acids, and when the mixture has cooled the materials to be dyed (silk, cotton, &c.) are to be completely immersed in the bath. Mr. Perkin's patent is dated August 26, 1856. In the early part of 1859 M. Verguin, a chemist at Lyons, while experimenting with aniline, discovered a process for converting it into a magnificent purple-red colouring matter. M. Verguin sold his process to MM. Renard and Franc, who patented the process in France on the 8th of April, 1859, and gave the new colouring matter the name of Fuchsine. The process is as follows:—A mixture of ten parts of aniline with six or seven of anhydrous chloride of tin is boiled for fifteen or twenty minutes. The mixture at first turns yellow, then becomes reddish, and ends by assuming a beautiful red colour when seen in thin layers; in the mass it appears black. Water is now added, and the whole is heated to ebullition. It is then removed from the fire, allowed to rest a moment for some insoluble matters to deposit, and then filtered while still hot; the residue is exhausted by another boiling with water. The filtered liquor contains the colouring matter in solution. To separate it advantage is taken of its being insoluble in a saline solution; accordingly, chloride of sodium or a neutral tartrate of potash or soda, in a solid state, is added to the liquor, and as the salt dissolves the colouring matter is deposited. It may then be separated by decantation or filtration.

Fuchsine may be employed for dyeing either in aqueous solution, without a mordant, or with the ordinary saline or acid mordants, always excepting the mineral acids, which alter the colour.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

On some Recent Researches in Physical Geography and Geology, by Professor D. T. Ansted, *M.A., F.R.S.*

Lecture VIII. *On the Antiquity of the Human Race.*

(Continued from page 261.)

We come next to the other contents of the caves. Associated with and among the bones of these animals that are almost all extinct, so far as this country is concerned, are found such specimens as are on the table before you. These three, for example [the Professor pointed to some trays before him], contain a number of specimens of flints found among the bones in these localities. When you examine these, I think it will be impossible for you to come to any other conclusion than that they were formed by human agency. Some of the specimens, taking them alone, would be sufficient to show that they were constructed by a number of blows probably of another flint, each blow chipping away a small portion. It is possible, though barely so, that one such specimen should have been formed accidentally; but, if you observe them, you will find that all are chipped away in the same manner, and by a peculiar method. They have been formed by blows, one striking on the right and the other on the left; they all have very definite shapes, being rounded at one end and pointed at the other; and, generally speaking, they have a depression on the under part. If, as is the case, we find such specimens, not only here and there, but in masses of fifty or a hundred together in one locality, the accumulated evidence evidently derived from their artificial character is quite sufficient to show that they were formed by some intelligent being. We know that no animals are formed in a way as to be able to construct these flints, and we are therefore bound to consider that they were formed by human agency. It is not necessary to detain you with any account of the peculiarities of these things, but it may be interesting just to allude to the way in which flints used to be manufactured for muskets; and these will show you how precisely the same effect is produced by artificial means. I have also here a specimen of one of the weapons used by the natives of Port Essington, in Australia, which is of a similar character. Another specimen [showing one] was broken off by a gun-flint-maker; and looking carefully at it, you may recognise the artificial character of the fractures. Next let us take up a number of the flints recently found in gravel and caverns. I think you will not be inclined to doubt, when you see them, that they must have been the weapons and instruments used by men; and no one, I believe, can

honestly arrive at any other conclusion. Seeing their evidently artificial character, we are bound to assume that they are human productions, and that is a point which I shall now take for granted.

We must now consider what proof there is that they were really found accumulated in the gravels belonging to a period very different from our own. You may say they were perhaps made by the Druids or the Celts, or the inhabitants of England immediately preceding the Danes, Saxons, or Romans. Now, it is a singular fact, that there was found, and carefully described and figured in a well-known antiquarian work, in the year 1797, an implement so exactly like those I am showing to you, that if you had it before you would not be able to distinguish one from the others; and since then several others have been found in the same locality. This deposit is in Suffolk, and the bed containing the flints is covered with sands and marls and red brick-earth. About twenty years after this discovery, a gentleman living at Amiens had a sort of instinct that there existed human remains in the gravel in his country, and he made up his mind to find them, and did find them. The three diagrams to which I now direct attention show the condition under which the remains were found, and several of the specimens themselves are before you. Where these were found the underlying rock is chalk; above the chalk is a series of beds of various kinds; and in the lowest of these beds, about 100 feet above the present valley of the Somme, are found the objects in question. A gravel similar to that in which they occur is accumulated in various patches all over the country. It is not necessary to mention the different places where they occur. It is enough to know that there are at least half-a-dozen places in the same neighbourhood, where patches of gravel have been found containing similar worked flints. These beds contain also remains of elephants, hippopotamuses, and rhinoceroses, in some abundance. There appear, in some cases, to have been pieces of wood immediately associated with the specimens themselves, presumed to have been the handles buried with them, and decayed. Pieces of bone found in the neighbourhood are supposed to show, in some cases, actual marks of weapons; and it is said that they could not have been broken accidentally in the way in which they are found, as they are bruised and broken with a dent, as if by stone knives or similar instruments. Above the beds containing the flint remains are several newer deposits, some of the uppermost of which contain other human remains, not of the same kind, though certainly belonging to a very ancient race. In the lower beds the weapons are roughly hewn, with other stones; but in the newer they are less roughly manufactured, and sometimes perfectly smooth and polished. In the upper beds of all there are remains of the Romans; while in the bottom deposit the human weapons are mixed with the remains of extinct animals totally different from those which now inhabit the country. Between the two are beds of sand, brick-clay, and earth, containing remains of animals much nearer the present time. Above that are the deposits containing remains of the Romans, and above that, vegetable soil.

It only remains now to consider whether by any chance these materials have been conveyed into the places where they are found, either by some natural operations much more recent than the formation of the deposits themselves, or by some human agency of late date; in other words, whether they have drifted accidentally into holes at the surface, or whether they have been buried in graves or the foundations of buildings of a comparatively recent time. This is a question that deserves careful consideration. I have no time to dwell on the various points of evidence; but when I tell you that a dozen of the most intelligent geologists, English and foreign, most of them commencing with a decided feeling that man was far too recently introduced to admit of his manufactures being buried with gravel of any date, have examined carefully the principal localities, taken the implements themselves out of the quarry, and examined most minutely the circumstances under which they occur:—I say that when, after such investigation, a conclusion is unanimously arrived at,—namely, that these materials are contemporaneous with the gravel,—we are bound to accept that conclusion. You must, therefore, take for granted that sculptured flints of human manufacture, such as I have shown you, are found in certain beds of gravel, mixed up and of contemporaneous origin with certain bones of animals found with and near them. No one is, I think, at present at liberty to throw any doubt on this conclusion, because the investigation has been made by competent observers with perfect honesty of purpose, and by persons whose integrity and knowledge of the subject is beyond any question.

I trust I have satisfied you now that flints, specimens of which are before you, and which have been found in marvellous abundance in some few localities—though hitherto only in a few—are beyond a doubt so constructed as to have required the hand of some intelligent being totally unlike in his intelligence any animal inferior to man; and also that these remains of man were found, really forming part, and often occurring in the lower part, of a great formation of gravels, and sands, and clays, or else in cavern deposits that must have taken a very long time to elaborate, and a still longer time to bring into their present position, and during the accumulation of which there lived in our latitudes large groups of quadrupeds that have long since become extinct.

Resembling in a general way the roughly-hewn implements and weapons belonging to other savage tribes, those from the gravel and caverns of England and Western Europe are yet different from them, and even of rougher make. In deposits of gravel above those which contain them are found, however, more modern specimens, similar in form, but more neatly cut, and even sometimes polished. Above these latter, or amongst them, are tools manufactured of copper and iron, evidently the work of a more cultivated race. Then come the remains of the Roman conquerors of Great Britain.

At some point in the history, but probably at a comparatively recent period, lived the race to whose labours we owe the wonderful group of stones at Stonehenge, and whose cromlechs and altars are dispersed over the westernmost extremity of European land. Were these the last remains of the ancient races driven towards the sea by advancing tribes of somewhat superior cultivation and higher organisation? This is a question that still remains to be answered. All we know is that the preservation of such monuments where we find them, seems to point to this conclusion, which is rendered more probable by what we see of the aboriginal inhabitants of America and Australia, who are becoming gradually lost races, owing to a similar advance of other and more civilized races.

There seems, indeed, to be a step arrived at in the gradual modifications that take place in the human family, beyond which there is no tendency, or even power, to go back, and no power to advance, by mixture with more civilised men. When civilised men occupy a savage country we generally obtain mixed breeds, but they only last for a few generations, rapidly degenerating both physically and intellectually from the higher type without improving the lower. If this be the law of Nature, it would help to explain much that is obscure in the history of man as well of domesticated animals.

Let me now sum up what appear to be reasonable inferences from the facts we have been considering.

On land, near England, then slowly emerging out of a sea traversed by icebergs, having a climate greatly varied, but on the whole warm, there roamed, at a very distant period, elephants and rhinoceroses, large deer and musk oxen, gigantic bears, tigers and hyænas, and numerous smaller animals, many of which are still common. In

the rivers of this land, or in pools and lakes there, were many species of hippopotamus, and we may safely conclude that there was a corresponding vegetation. It could hardly have been a small tract to support these gigantic quadrupeds; it is more likely to have been a fragment of one much larger which had been partly submerged.

The hyænas and the bears then occupied caves in the limestone rocks as dens, and carried thither their prey. The British Islands formed no separate group, and the whole Continent of Europe was probably but an archipelago. But at this time, when land was so differently distributed, when the animals, especially the larger ones, were so different, there existed tribes of savages,—troglodytes, perhaps,—sheltering in holes in the ground, or sharing caverns with the wild beasts, but not without the will and the power to manufacture flint arrows and hatchets, and spear-heads, that could be fixed in simple handles with thongs, and form implements for use, or weapons for defence or offence. These early inhabitants of the western lands may not, however, have been the first, although at present no appearances of human ingenuity have been seen among the remains of the earlier and warmer land, peopled by different species of elephant and rhinoceros, and apparently by many other animals equally characteristic. The beds above the glacial drifts of the boulder clay, or the beds of boulder clay itself, contain the first yet found of those rude implements attributable to human agency.

Perhaps at this same time there existed a similarly imperfectly-developed family of the human race in America; and it may be that their representatives in Africa, on the banks, and at the mouth of the Nile, were then, as they certainly were afterwards, a dominant, because a more educated race.

The earliest human inhabitants of Western Europe must, however, have lived together,—they must have had a common policy,—for their weapons are all constructed according to one idea, though all are simply and roughly made, and meant for use rather than ornament. There is little symmetry of form, and often extreme carelessness of execution. So marked is this want of finish, that many of the specimens, although their character is seen when they form parts of a series, are hardly artificial enough to decide their human origin. Thousands of them are found near together; they have been shaped merely by striking one flint against another, and it seems likely that for one perfect instrument made and used there were hundreds chipped off and thrown away during the progress of manufacture. This would account for the vast number of small arrow-heads or chips in comparison with the larger and more completely finished specimens.

Our early ancestors, if the tribes who constructed the flint weapons must so be regarded, may have continued with similar habits for an indefinite time. By degrees the manufacture of flint weapons probably improved, and we find in the newer gravels, in the surface deposits, and in the mouths of caverns, clear proofs of more perfect chiselling, and an approach to polish. But consider the number of years during which this change must have been going on. The climate and vegetation once permitting elephants, rhinoceroses, and hippoptamuses to flourish, must have been altered by a new distribution of land. These animals, however, spread widely, reaching even the Arctic Circle; whole species were introduced, became abundant, became scarce, and entirely disappeared; while man, though adapting himself to changes that they could not endure, hardly seems to have developed sensibly in instinct or intellect. Whole tribes of human beings, the early inhabitants of unknown lands, have doubtless been replaced by other families of the great human race. Generations after generations have been born—have lived, and died,—tribes have succeeded tribes, families have driven out families, and scarce anything is left behind but a few spear-heads and flint hatchets buried in caves with the bones of the bears and hyænas, or mixed with ancient gravels collected when the elephant was perhaps as common as the man. But the stamp of time is indelibly impressed on these rude flints, not less clearly than the marks of their human origin; one has a coating of white decay on the surface; another, little crystals of manganese; almost all have something to substantiate the inference that they are of equal antiquity with the stones and the bones with which they are found.

Not the less certain is it that man is a creature of yesterday. For every year that has elapsed since he appeared, centuries have passed away in the elaborate preparation for his presence. The ocean had covered the depressions of the land, and had helped to produce the successive deposits; the depths of the ocean had received film after film of fine mud, the remains of animalcules; the iceberg had carried and accumulated numerous deposits; the shores and shallow depths of the ocean had been peopled from time immemorial with animal and vegetable forms of life long before even the commencement of the last great period. There were then, however, other continents, and the groups of islands of that time were the summits of our mountains. Central Africa and Central Australia were then vast lagoons, having an outer wall of low islets. Earthquakes, however, then disturbed and elevated the lands, and there were eruptions from volcanoes which differed perhaps but little in intensity from those recently described, though the rents were not where they now are seen. Then, as ever, water circulated through the earth, and rocks were in the course of formation, governed by the same laws as those we still trace, and which are concerned in reconstructing the ever shifting framework of the earth.

With these few general and connecting remarks, I now bring to a conclusion my somewhat disconnected course. It occurred to me—and I believe I may venture to hope that I was not mistaken—that a sketch of the present condition of some questions in geology and physical geography would afford matter for useful and interesting illustrations; and now, in taking leave of you, let me very briefly show you how living and present is the interest in most of the subjects I have put before you.

Within the brief weeks that have passed since my first Lecture, an unusual condition of the Atlantic Ocean has been more than once the cause of some of those fearful and destructive cyclones, or spiral storms, that desolate the earth and sweep along our shores. One of these we have experienced since we last met. Before long we shall probably learn that the icebergs coming down from the Polar Seas are of unusual dimensions, and reach to latitudes seldom visited by such phenomena.

Within a few days it has been determined to send out an expedition to sound the depths of the Atlantic in a new direction, with a view to repeat under more favourable circumstances the experiment of connecting America with Europe by a telegraphic cable. I am happy to know that on this occasion there will be a naturalist on board, as capable as he is willing to clear up all the doubtful points with regard to the mud of the ocean floor and its contents, living or dead.

At the present moment I trust our brave countrymen are busy exploring still further Central Africa and Central Australasia. Captain Speke is on his way to trace the waters of Lake Nyanza, north of the equator, hoping thence to reach and descend the Nile; and Dr. Livingstone, from the mouth of the Zambesi, is filling up the gaps that still remain in our maps of the east coast of Africa.

Since I spoke of earthquakes, we have been told in the public newspapers of fearful and destructive shocks destroying one of the chief cities of Peru; and it is not improbable that these may have terminated with a violent

volcanic outburst. Vesuvius seems to be symbolising at the present moment the political uneasiness of Italy.

In all these, and indeed in all departments of science and natural history, knowledge is increasing; and the discoveries of one department are every day more clearly seen to bear on every other. If, then, we pause for a time from other avocations for the purpose of acquiring general information and learning what is most recently discovered in science, we find that before we have even completed our inquiries, new discoveries, new methods, new views are thrusting themselves forward, threatening to displace the very novelties we have hardly prepared ourselves to admit. It is only thus that we can learn the enormous difficulties that lie in the way of successful generalisations, and excuse the shortcomings incident to attempts like that which I have undertaken, and which I now terminate.

NOTICES OF BOOKS, PATENTS, &c.

A System of Instruction in Quantitative Chemical Analysis. *By Dr.* C. Remigius Fresenius. *Edited by* J. Lloyd Bullock. Third Edition. London: John Churchill.

For some time past a copy of Fresenius's standard work on Quantitative Chemical Analysis has not been obtainable, and many admirers of that experienced Chemist's analytical works will no doubt have anxiously looked forward to obtain an English version of the much enlarged and carefully revised fourth German edition. They will be pleased to learn that Mr. Lloyd Bullock has at last completed the arduous labour of editing this work, which in its present appearance justifies the words of the preface,—that it has been entirely re-cast, considerably simplified and almost re-written; new matter having been introduced to the extent of one-fourth of the whole volume. Quantitative analytical chemistry has been greatly enlarged and enriched during the last decennium by the labours of such men as Bunsen, H. Rose, Fr. Mohr, &c., which have led to many beautiful and fruitful results. The general tendency of all analytical labours has in this interval seemed to have been directed towards replacing the often tedious gravimetrical methods by more expeditious, but equally accurate, processes, and have given rise to a new system of quantitative analysis—the Volumetrical Method. The impulse once given, it could scarcely be restrained—the weeds grew with the corn; for, in the words of Fresenius, volumetrical methods were sometimes published by chemists merely for the sake of gratifying the desire of seeing their names in print; methods which were, perhaps, only applicable in a few special cases, or which were often altogether faulty or useless. All those who have had occasion to give some attention to the rapid growth of this new branch of chemical analysis, and have followed generally-acknowledged guides, such as Fr. Mohr's "Titrirmethoden," will agree with us that it was highly desirable that the new material which had so bewilderingly accumulated should meet with a thorough critical sifting by some master hand, capable of stripping it of its swaddling clothes, and allowing it a free and healthy growth. This has been ably done by Fresenius in the present new edition, and if the book before us had no other merits than those of a thorough weeding of the forest of volumetrical methods, adopting what was really good and of practical application, and thus presenting us with the much-desired English guide in the field of expeditious and practical volumetrical analysis, it would on that account alone recommend itself to many of our readers. Whilst retaining the general plan of the work, Fresenius has found space for treating of the best volumetrical methods, for pointing out inferior, and cautioning the student against faulty processes, for noticing the masterly labours of Bunsen—the elementary character of the work scarcely allowing of a more ample notice,—when treating of the analysis of mineral waters and of atmospheric air, and for giving more attention to the Special Part.

As far as it is possible to judge of the value of this work from a careful examination, we can give it our cordial approbation; many of the analytical processes which we have here met with are quite new, and appear to be great improvements upon those in common use. Of their real value in the laboratory we shall be able to speak with more confidence on a future occasion; we have adopted many, and have as yet seen no reason to wish to recur to the old methods. The comments and experiments made by the author upon the numerous new processes which have been from time to time proposed are especially valuable. It is an inestimable boon to be able to fall back upon the critical acumen of so skilled an analyst as Dr. Fresenius in forming an opinion on the feasibility of some plausible process, instead of being dependent upon the laudatory description of the inventor. The Doctor's experiments in this direction, and the analytical notes in the appendix, are, in our opinion, the most valuable portions of the work. They show consummate skill and accuracy, and are always conclusive.

An enumeration of some of the special methods of analysis may perhaps be acceptable to many of our readers. The very first, the analysis of waters, will be found on examination to contain much new material, and may safely be recommended as the best guide to the correct analysis of mineral waters. We are, however, sorry to see that no reference is made by the Editor to the English method of arranging the results of a water analysis by calculating the several constituents upon the imperial gallon (70,000 grs.), and it is left to chance to determine whether the student will become acquainted with that arrangement of the results of a water analysis, which has been almost generally adopted by English chemists. It would be highly desirable if the plan of a simultaneous arrangement of the results of a water analysis per mille and per imperial gallon were more generally adopted by the analyst. The remarks on the estimation of organic matter, volatile or non-volatile, in waters, and on the analysis of sulphuretted waters, will be found especially acceptable. In the chapter on Acidimetry we find an additional table by Mohr, giving the relations between the specific gravity and the amount of hydrated acetic acid, and also a method for estimating free acid in presence of neutral salts with acid reaction. To Dalton's tables for ascertaining the per-centage amount of anhydrous potassa and soda from the specific gravity of the solution, have been added enlarged tables by Tünnermann, which will be found useful in alkalimetrical analysis, as well as the additional volumetric methods for determining carbonate of soda in presence of carbonate of potassa, and of the alkaline earths, in the caustic state, or as carbonates, by means of a standard solution of nitric acid. The chapter on Chlorimetry contains little that is new, and we have only to notice Fr. Mohr's slight modification of Penot's method. In the determination of manganese ores, Fresenius insists, with good reason, upon bestowing the utmost attention upon a careful preparation of the sample for analysis, and upon the estimation of moisture in the ore, and describes, moreover, a method for determining the different amounts of hydrochloric acid, which various manganese ores require whilst containing the same amount of available oxygen. When treating of the estimation of gunpowder, the analysis of silicates, of clays, limestones, etc., Fresenius has, without extending the subject too much, added a good deal of fresh material. Every one who has had experience in the analysis of iron ores, will agree with our author, that a solution of permanganate of potassa deserves the preference of all other methods for determining iron volumetrically. An indirect method for the estimation of iron by means of metallic copper, will also be found in this new edition. The work treats further of the analysis of

copper pyrites, and galena, where a careful description of the methods for determining small quantities of silver in lead ores is given. To the analysis of zinc ores are added several methods for the volumetric determination of zinc, which will be perused with interest; and altogether new is a valuable chapter on the analysis of cast iron.

A supplement contains the methods for the determination of sugars, starch, and dextrine, both by volumetrical analysis and by fermentation. The chapter on the analysis of the ashes of plants remains without material alterations, whilst the following one on the analysis of soils has undergone a thorough re-arrangement, and will be found a safe guide to all those who are engaged in this branch of analysis. Fresenius refers to Liebig's letters "On Modern Agriculture," to show the necessity for the alterations which he introduces in this new edition, advising a mechanical analysis of the soil to precede the chemical analysis—a plan which will certainly insure a more comprehensive insight into the true nature of a soil. In the analysis of manures, reference is made to the improved method of Schlösing for the determination of nitric acid, instead of the unsatisfactory method of Martin, and we may here mention that the methods for the determination of nitric acid given in the present edition, will be found far more acceptable to the analyist than in the former edition. No mention is made, however, of Pugh's method (by means of protochloride of iron), published some years ago. Entirely new is the chapter on the analysis of superphosphates, and of ground bones, and it deserves careful perusal. Fresenius recommends here, as well as in other places, the employment of acetate of sesquioxide of uranium for the estimation of phosphoric acid in combination with alkalies and alkaline earths. To the analysis of atmospheric air, the last of which Fresenius treats in his work, have been added two improved methods for the determination of the carbonic acid, one by Fr. Mohr; the other method for the absorption of oxygen by copper moistened with hydrochloric acid, has been omitted in the new edition.

Our space will not admit of noticing in detail the numerous additions made in other parts of the work, but we may mention that the section on Organic Analysis has found a suitable addition in Simpson's method, for the determination of nitrogen, and in a supplement containing a description of Hofmann's combustion-furnace, extracted from the *Quarterly Journal of the Chemical Society*.

The publisher has spared no expense in rendering this work as useful as possible to the student of Analytical Chemistry. In spite of its being printed more closely, there will be found about sixty pages more text, together with many more illustrations; whilst the price of the book has only been slightly raised. The woodcuts and the printing, however, are inferior to the general getting up of the German edition.

There are a few errors—in what chemical work of similar extent have they ever been entirely avoidable? For instance, we notice, upon comparing this edition with the first, that the value of a gramme in English grains has been altered—not on the side of greater accuracy. The first edition gave the weight of a gramme as being equal to 15·4336 grains troy. In the present volume we find its value given as 15·4346 grains. We believe we are correct in stating that the real equivalent in grains, to a gramme, is 15·43235; and this relation is actually borne out upon a comparison of our standard grain weights, by Oertling, with a standard gramme. The incorrect value given in the former edition certainly required correction, but why it should have been replaced by a still more erroneous equivalent we are at a loss to conceive. The very meagre list of errata might also have been extended with advantage. At present the whole of these alterations but one fall on one page of the book (p. 7); and when the letter-press is erased, and the alterations substituted with the pen, it causes so great a disfigurement to the book, that we are surprised the publisher could permit such a page to be perpetuated in binding. The leaf ought to have been cancelled, and another corrected one substituted.

These, however, are trivial matters, which scarcely detract at all from the value of the work. All credit is due to Mr. Bullock and his coadjutors for the able manner in which the German text has been rendered in English; and we feel confident that the work will be received with pleasure by all engaged in the practice of Analytical Chemistry wherever the English language is spoken.

Preparing Magenta Red. THOMAS DIX PERKIN.

MR. W. H. PERKIN calls our attention to the fact of our having omitted his brother, Mr. Thomas Dix Perkin's patent for preparing Magenta red, from the Table given in the 48th number of our Journal. We stated, at the commencement of the article containing that Table, that our list was somewhat imperfect; and we are glad to have the opportunity of supplying the omission.

The reagents claimed are the per-nitrate and sub-nitrate of mercury, and the per-sulphate and nitrite of mercury. To 10 parts of aniline or its congeners, 6 or 8 parts of the salt are added, and the whole is boiled until it becomes red; and the mixture, on cooling, assumes the form of a crystalline paste. The colour is extracted from the crude product in the usual way. Dated 15th November, 1859, being a communication from M. Knosp, of Stutgart.

The *bichlorides* of mercury is, as we stated in our last article, claimed in Renard's communication, dated 12th April, 1859. It is also claimed again in Renard's second communication, dated 27th October, 1859. The great advantage of the mercury process, which consists in the recovery of the metal, applies to the bichloride as much as to the nitrate of mercury. The final result of the reaction appears to be the same in both cases.

We stated in the article previously alluded to, that the reason Mr. W. H. Perkin did not proceed with the patent which he had provisionally taken out for the use of bichloride of mercury, was probably from the fact of his having been forestalled by Renard Frères. Mr. Perkin, we have since ascertained, was not aware at the date of his provisional specification (1st November, 1859), that MM. Renard had previously claimed that reagent in their patents dated respectively the 12th April and 27th October, 1859.

CORRESPONDENCE.

Cleaning of Platinum.

To the Editor of the CHEMICAL NEWS.

SIR,—A remarkably rapid and perfect method of cleaning platinum apparatus consists in gently rubbing upon the dirty metal a small lump of sodium-amalgam. Sodium has the curious property of lending to mercury the power of "wetting" platinum in so complete a manner that the positive capillarity between platinum and an amalgam containing even only a few per cent. of sodium appears to be as great as that between mercury and zinc, with this important difference, however,—in the former case the "wetted" metal does not suffer the least trace of amalgamation. Even when foreign metals, such as lead, tin, zinc, silver, are purposely added to the sodium-amalgam, the platinum surface suffers no disintegration.

When the amalgam has been rubbed on with a cloth, until the whole surface is brilliantly metallic, water is applied, which oxidises the sodium and allows the cohesion of the mercury to assert itself. On wiping the mercury off, the platinum surface is left in admirable condition for the burnisher. I suppose the sodium to act here chiefly as a diluent, diminishing thereby the cohesion of the

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Juices of the "Ficus Elastica" and the "Isonandra Gutta" (India Rubber and Gutta Percha), by A. ADRIANI, *M.D., Math. Mag. Phil. Nat. Dr. F.R.N.I.E., &c. &c.*

(Continued from page 279.)

A drop of hydrofluo-silicic acid gives rise to the formation of a few, but perfectly well-defined, crystals of silico-fluoride of sodium; these crystals, however, are only quite clearly seen after a few hours. Tartaric acid fails to give rise to the formation of any crystals, even in the concentrated solution of the ash; a very minute addition of very dilute sulphuric acid gives rise after a few hours to the formation of a few well-defined crystals of sulphate of lime. Phosphate of ammonia produces, even in a more dilute portion of the solution, a copious precipitate of ammonio-phosphate of magnesia. Ferrocyanide of potassium fails to produce the slightest blue colour, even after addition of a drop of acid. The base, therefore, which is present in the largest quantity is magnesia, and the crystals before mentioned are made up of an organic acid combined with magnesia; the ash also contains small quantities of lime and soda. Since the shape of the organic magnesia salt did not present any analogy with that of other well known combinations of magnesia with organic acids,[1] I tried to obtain a small portion of the acid in free state. This was done in the following way:—A large portion of the freshly-taken milky juice of the *Ficus elastica* was evaporated to dryness on a water bath, and the dry mass was treated with pure ether as long as anything remained soluble therein; what was left was easily soluble in water, and to the clear aqueous solution a clear solution of acetate of lead was added; this gave rise to the formation of a white precipitate; this precipitate was collected upon a filter, washed and dried. After having been dried, the filter with its contents was carefully cut to pieces and put in a glass, and distilled water poured over it, while a slow current of pure sulphuretted hydrogen gas was passed through the liquid and its contents for some time; the sulphuret of lead having been separated by filtration, the liquid (viz. that which passed through the filter) was evaporated to a syrupy consistency and left to itself; after a couple of days there had been deposited regularly shaped octaëdral crystals; these crystals are the organic acid in question. Although I had only got a few milligrammes of the acid, that quantity was sufficient to prove that it presented no analogy with any other known organic acid. The crystals are readily soluble in water, but not so in alcohol, which also precipitated the aqueous solution. It (the acid) combines with ammonia, yielding a crystalline combination. The true shape of the crystals could not well be determined, in consequence of their extremely small size. The acid yields amorphous precipitates with the carbonates of soda and potassa, soluble only in large quantities of water. A solution of 1 part of carbonate of potassa and 200 parts of water gave even a large precipitate. No precipitates were formed in the solutions of sulphate of soda and nitrate of potassa; neither also in solutions of sulphate of magnesia, chloride of calcium, sulphate of copper, or persulphate of iron. The acid yields amorphous precipitates with solutions of acetate of lead, nitrate of silver, chloride of barium, and caustic baryta. The precipitates with chloride of barium and nitrate of silver are insoluble in nitric acid: the latter is also insoluble in ammonia. It is hence apparent that this acid is especially distinct from other organic acids, by the difficult solubility in water of its combinations with potassa and soda, while it yields readily soluble salts with lime, magnesia, and iron; so that if the acid in question could be got in larger quantity it would be a very valuable re-agent for the separation of the alkalies from lime, magnesia, and iron in analysis.

Since the juice of the *Ficus elastica* is among those which are largely taken from these trees to obtain the caoutchouc therein contained, it might be readily so arranged that while collecting the juice, the more aqueous portion, which contains the organic acid combined with magnesia, were separated from the cream, so to speak; for the caoutchouc globules float, like cream does upon milk, on the surface of the fluid, if it is left at rest for a few hours.

The composition of the freshly-taken milky juice of a sound and healthy-grown[2] *Ficus elastica* was found by me to be as follows:—

	Per cent.
Water	82·30
Caoutchouc	9·57
Resin, soluble in alcohol, but not in ether	1·58
Magnesia combined with a peculiar organic acid	4·49
A substance soluble in water and alcohol, but not in ether (sugar?)	0·36
An organic substance, soluble in water, which gets a yellow tinge with alkalies (dextrine), and traces of salts of lime and soda	2·18
	100·48

Both Dr. Faraday and Dr. Ure have had the opportunity of analysing and experimenting upon the liquid caoutchouc,—*i. e.*, the milky juice brought over from India to Europe in close copper vessels. According to Faraday's analysis, the juice contained 31·70 per cent. caoutchouc; 1·9 per cent. albumen, with traces of wax; 7·13 per cent. of a peculiar bitter extractive matter, containing nitrogen, soluble in water and in alcohol, with a brownish colour, and precipitable by nitrate of

[1] Many of these, especially the more rare ones, I purposely prepared to ascertain their shape, as seen by the aid of the microscope for the sake of comparison, and to make sure against wrong deductions.

[2] In a hot-house; the tree was three years old.

protoxide of lead; 2·9 per cent. of a substance insoluble in water and alcohol; and 56·37 per cent. water, mixed with a small quantity of a peculiar acid precipitable by salts of lead. Heat and addition of alcohol cause the juice to coagulate, and, once coagulated, it is impossible to bring caoutchouc again to the emulsive state. Ure says that the juice he experimented upon was not coagulated by alcohol of 0·825 specific gravity. The specific gravity of caoutchouc varies considerably. Juliaans, who wrote a dissertation on caoutchouc in 1780 ("Dissertatio Chemica Inauguralis, de Resina Elastica Cagenensi," Trajecti ad Rhenum, 1780), found the specific gravity to be 0·920. Dr. Ure found 0·925 and the following figures:—

Caoutchouc from	Para, Brazils .	0·941567
„	„ Assam, East Indies	0·942972
„	„ Singapore . .	0·936650
„	„ Penang . .	0·919178

I (Dr. Adriani) found the specific gravity of the rough, *i. e.* unmanufactured, caoutchouc of India (the kind imported resembling large pieces of cured bacon), at 20° C., 0·9628; while, at the same temperature, I found the specific gravity of the black-coloured[3] kind of caoutchouc, frequently imported in the shape of bottles or flasks, 0·9452, great care having been taken to remove any adhering bubbles of air from the substances submitted to experiment. The caoutchouc obtained by Dr. Faraday from the milky juice in a pure state, had a specific gravity of 0·925.

The specific gravity of gutta percha also seems to vary considerably. Soubeiran found 0·9791; Klaproth 0·9714; Pasquier, 0·9791; I found rough, *i.e.* unprepared, gutta percha, at 17° C., 0·99923, while at 18° C. I found the purified gutta percha, from the works of Munnich, Beek, and Co., at Amsterdam, to possess a specific gravity of 0·9667; for two other samples from the same works I found the specific gravity, at 17° C., 0.96285, this being rolled into sheets on an average 0·0054 mètre, = 0·212602266 English inch, thick; the specific gravity of the other I found, at 17° C., 0·96289. The latter being a piece of new machine-belt, was applied by me to a series of experiments, to determine the permanent stretching in length and the elastic stretching and subsequent contraction, or, in other words, the degree of elasticity possessed by gutta percha. The piece of the belt, quite straight, was immoveably fixed and hung up in such a manner that it was possible to attach weights at the bottom end, and by means of very thin marks made with ink, which were looked at through the telescope fixed to a very correctly-made cathetometer, with which it was possible to distinguish $\frac{1}{100}$ millimètre (0·0003937079 English inch) difference in length, I estimated the effect of a certain weight attached to the bottom end of the belt. The original length of the belt was 0·66628 mètre; 3 kilogrammes having been attached to it and left there for *one* hour, the length was found to be 0·66987 mètre. One-half kilogramme was now taken off, and, as in the first case, the observations were made with the cathetometer, at intervals of ten minutes. After the 2·5 kilogrammes had been left for *one* hour, I found the length to be 0·66944 mètre; the contraction due to elasticity, 0·43 millimètre.

Length of belt after *one* hour's effect of the weight of 2 kilogrammes, 0·66904 mètre; elastic contraction, 0·40 millimètre.

Length of belt after *one* hour's effect of the weight of 1·5 kilogrammes, 0·66850 mètre; elastic contraction, 0·46 millimètre.

Length of belt after *one* hour's effect of the weight of 1 kilogramme, 0·66795 mètre; elastic contraction, 0·63 millimètre.

Length of belt after *one* hour's effect of the weight of 0·5 kilogramme, 0·66758; elastic contraction, 0·37 millimètre.

Length of belt after *one* hour's effect of 0 kilogramme, 0·66679 mètre; elastic contraction, 0·97 millimètre.

The elastic stretching for a weight of 3 kilogrammes is, therefore, equal to 3·08 millimètres; the permanent stretching for the same weight is equal to 0·5 millimètre. The room in which the experiments took place had a temperature of 17° C., and being very large, I had taken the precaution to have very sensitive thermometers placed in different parts of the room to indicate its temperature. It remained constant at 17° C. during the time of the above-detailed experiments. As already mentioned, the observations were made with the cathetometer at intervals of ten minutes, so that the results given above are the mean of six observations each. I was assisted by Mr. Cohu, the able mechanic to the Museum of Natural Philosophy (physique), while Professor Dr. R. Van Rees had the kindness to give me the use of his splendid lecture-room for these experiments, as also the use of such instruments as I did not have of my own. As I wished to have some idea of the absolute strength of the same piece of gutta percha, I found it broke under a stretching weight of 106 kilogrammes. The thickness of this belt was 1·775 millimètres; its width was about 6 centimètres, equal to 2·362 English inch. According to experiments of Feistmantel, the square inch of gutta percha is not broken (crushed) unless loaded with 3744 lbs. weight. It need hardly be repeated that gutta percha tubing has withstood the enormous pressure of 24 atmospheres per square inch without bursting,—*i. e.*, equal to 730 lbs. upon the square inch.

Gutta percha is often adulterated with the milky juice of another plant, or various other plants. One of these substances used for adulterating it is called *Getah Malabeoeya*. M. Robbu, at Amsterdam, gave me some of that material: it had a greyish-green dark colour, was brittle; when broken, the fracture was of a dirty white colour; it gave off a very disagreeable smell; it was somewhat sticky, not unlike glazier's putty. In the unprepared, not purified, state I found its specific gravity at 17° C., = 0·97772; while for that which had undergone a purifying process, I found the density at 17° C. = 0·9535.[4] It dissolves in the same solvents as gutta percha, and, like the solution of the latter in chloroform, it is precipitated from that menstruum by alcohol. Gutta percha adulterated with *Getah Malabeoeya* exhibits a different colour from that which is not so adulterated; the sample given me by M. Robbu had a specific gravity at 17° C. of 0·982239; was less readily soluble in the usual solvents for gutta percha; especially, also, more difficult of solution in chloroform; it was found not to answer well for being purified and manufactured as the pure gutta percha. I found the *Getah Malabeoeya*, in the rough, or unmanufactured, state to give by elementary analysis 77·77 per cent. C, 10·57 per cent. H, 11·65 per cent. O; while I ascertained the presence of N by Lassaigne's test: the

[3] The black colour is due to minutely-divided soot, derived from the smoke of the smouldering fires over which the milky juice is evaporated.

[4] This great difference is due to the removal of impurities, among which is sand, as Mr. Munnich told me. This was added, it appears by the Chinese to increase the weight.

material was dried over sulphuric acid, a portion weighed off and left over sulphuric acid until no more loss of weight followed; it was then deemed dry. Of course it was previously as minutely divided as possible. This mode of drying was compared with drying by means of a current of dry air, and in an oil-bath, heated to 120° C, but beside the risk of these "caoutchouc-körper," (to use the German expression for this class of bodies,) losing some of their constituent parts at that heat, they get soft and stick so tenaciously to the sides of the drying-tubes that it is almost impossible to get them out without breaking the tubes.

The *Getah Malabeooya* contained in 100 parts 0·396 parts per cent. of ash.

Rough gutta percha gave 5·18 per cent. ash.

Pure gutta percha, after having been treated with boiling water, cold and boiling alcohol, and ether, and having been dissolved in chloroform, the solution filtered and precipitated with alcohol, and washed with boiling alcohol, gave 0·314 per cent. ash.

Rough caoutchouc (Indian) gave 0·487 per cent. ash.

Caoutchouc, pure, treated as described for gutta percha, gave 0·333 per cent. ash.

The ash of gutta percha contains lime, magnesia, potassa, oxide of iron, silica, sulphuric acid, and chlorine.

Vulcanised gutta percha from the works of Munnich, Beek and Co., at Amsterdam, yielded 8·35 per cent. sulphur; its specific gravity at 17° C. was 0·97665. Vulcanised caoutchouc (Patent Perryian Elastic Bands) yielded 11·30 per cent. sulphur. The vulcanised caoutchouc was no longer soluble in its ordinary solvents, not even at increased temperature. The vulcanised gutta percha dissolved in chloroform, but more slowly.

As far back as the beginning of 1850, the Engineer-in-Chief for the electric telegraph in the Netherlands, M. E. Wenckebach, called the attention of the scientific public to the utter unsuitableness of gutta percha as isolating coating for telegraphic wires and cables for underground and sub-aqueous use; his experience had then already decided in favour of vulcanised india-rubber.[4] At the meeting of the Fellows of the Royal Netherlands Institution of Engineers, of the 12th of February, 1850, M. E. Wenckebach gave a few results[5] of his experience of the use of both these substances on the telegraph line from Amsterdam to Rotterdam, *via* Hague, along the line of the Holland Railway Company, which line, in a length of about 43 English miles, counts as many as 90 bridges, of all sorts and shapes, and certainly beyond 40 sub-aqueous telegraph cables.

(To be continued.)

Separation of Alumina from Lime and Magnesia, and Lime from Strontia, Sesquioxide of Iron, &c., by M. H. Rose.[1]

The method of separating lime from alumina by means of ammonia has been improved by M. Rose. Instead of being careful to employ ammonia free from carbonic acid, and avoiding the presence of this gas, he heats to gentle ebullition the liquid in which the alumina has been precipitated by excess of ammonia. When the evolution of ammonia ceases, all the alumina is in the precipitate, and may be separated by filtration without requiring any special precaution,[2] for the simple reason, that in the presence of ammoniacal salts the carbonate of lime is decomposed, the lime entering into solution. A little sal ammonia may even be added, if there is a chance of there not being sufficient to favour this decomposition.

When the lime is only present in small quantities, tartaric acid may be added, and the solution then supersaturated with ammonia. The lime is precipitated in the form of tartrate if there is only a little alumina present; otherwise, it remains in solution, but can be perfectly separated in the form of oxalate.

The same process is applicable for the separation of magnesia, although it has not quite the same accuracy, owing to the alumina always carrying down traces of this base. It may also be employed when the aluminous liquid contains both magnesia and lime. The tartaric acid process may also be used, the lime precipitated by oxalic acid, and the magnesia in the state of ammonio-phosphate of magnesia.

The process with ammonia first described, may also serve to separate sesquoxide of iron from lime and magnesia; although it is the case that the sesquoxide of iron always carries down small quantities of lime when precipitated by ammonia, this lime is redissolved on ebullition, as shown above. This plan is, however, incorrect for the separation of oxide of zinc.

To separate lime from strontia M. Rose prefers Stromeyer's process, based upon the solubility of nitrate of lime in absolute alcohol and the insolubility therein of nitrate of strontia, only he proposes to add an equal volume of ether to the alcohol. Whilst alcohol can dissolve the $\frac{1}{8800}$ part of nitrate of strontia, a mixture of alcohol and ether does not dissolve more than $\frac{1}{60000}$, without its ceasing to dissolve perfectly the lime salt.

An analogous separation may be effected by sulphate of ammonia, in which sulphate of lime is soluble, whilst sulphate of strontia remains unaffected. The proportions to employ are, 50 parts of sulphate of ammonia and 200 parts of water to 1 of sulphate of strontia.[3] There is then formed a soluble double salt, which resembles potassio-gypsite (sulphate of lime and potassa). This process is, however, less delicate than that of Stromeyer.

TECHNICAL CHEMISTRY.

On the Preparation of Artificial Colouring Matters from the Products extracted from Coal Tar, by M. E. Kopp.

(*Continued from page 282.*)

A red colour is also obtained by acting on aniline with other anhydrous metallic chlorides, bichloride of mercury, perchloride of iron, protochloride of copper, for example. In October, 1859, MM. Renard and Franc added to the above three anhydrous chlorides the hydrate of bichloride of tin, as being equally able to change aniline into fuchsine. A second addition to their patent, in November, 1859, extended the list of colorige-

[4] Spun round the electric telegraph wires.

[5] M. E. Wenckebach showed to the meeting various parts of coated wires of the line of telegraph mentioned, which, although only having been in use for three years, were so damaged as to render their renewal necessary. Some of these wires were coated with gutta percha, some with India-rubber. Those coated with vulcanised India-rubber were sound, notwithstanding they had been equally much exposed.

[1] *Annal. der Physik und Chem.*, t. cx. p. 292.

[2] The estimation of alumina is accompanied with an inconvenience known to all chemists; this is, that gelatinous alumina is difficult to wash, owing to its stopping up the pores of the filter-paper. Bearing upon this point, M. Rose draws attention to a *tour de main*, which consists in allowing the alumina to slightly dry upon the filter. In this state it may be perfectly well washed in a short time.

[3] Lime?—Ed. C. N.

nous agents by including the stannous and stannic sulphates, the mercurous and mercuric sulphates, mercurous and mercuric nitrates, nitrate of silver, titanic chloride, mercuric fluoride, stannic and mercuric bromides, and stannic iodide. A third addition, in the same month, added the ferric and uranic nitrates, uranic chloride and mercuric chlorate, bromate, and iodate. Sesquichloride of carbon and iodoform were afterwards added in December of the same year. Lastly, a fifth addition was made in February, 1860, the purport of which the author does not exactly know, but which, he believes, includes iodine, arsenic acid, and nitric acid.

We must here quote from a paper by Dr. Hofmann, presented to the Academy of Sciences, on September 20th, 1858,[1] and entitled, "Contributions to the History of the Organic Bases: IV. Action of Bichloride of Carbon on Aniline":—

"At the ordinary temperature of the air, aniline and bichloride of carbon do not act on each other. At 100° C. the mixture begins to change; but after digesting for some days, the change is far from being complete. By submitting, however, a mixture of one part of bichloride of carbon and three parts of aniline, the two bodies being in the anhydrous state, to a temperature of 170° or 180° (the boiling point of aniline) for nearly thirty hours, the liquid is changed into a blackish mass, soft and viscous, or hard and brittle, according to the duration of the temperature. This blackish mass is a mixture of several bodies. By exhausting with water a part is dissolved, another part remaining insoluble in a resinous state. With the aqueous solution potash gives an oily precipitate, which contains a considerable proportion of unchanged aniline. On distilling this oily matter with diluted potash, aniline passes; while a viscous oil, which solidifies by degrees, remains behind. Repeated washings with cold alcohol, and one or two crystallisations from boiling alcohol, render the body perfectly white and pure; a very soluble substance of a *magnificent crimson colour* remaining in solution.

"The blackish portion of the mass which remains insoluble in water, is easily dissolved by hydrochloric acid; from this solution it is again precipitated by alkalies, as a dirty-red amorphous powder soluble in alcohol, and forming a *rich crimson coloured solution*. The greater part of this colouring matter is the same as that which accompanies the crystalline fatty body, considerable quantities of this latter substance being sometimes found in the product insoluble in water."

The great resemblance between the experiments of Dr. Hofmann and the process of MM. Renard and Franc is evident. If, as appears from the fourth addition to their patent, fuchsine may be prepared by boiling sesquichloride of carbon with aniline, it is quite clear that Dr. Hofmann had fuchsine in his hand, and that it is identical with the substance which gave a magnificent crimson solution. It is right, however, to add, that if Dr. Hofmann was the first who obtained fuchsine as a secondary product in his theoretical experiments, M. Verguin has certainly the merit of having modified the process, so as to make it capable of industrial application.

In October, 1859, M. Gerber-Keller patented in France the preparation of a red colouring matter, which he called Azaleine, "by means of aniline treated under the influence of heat and in proper proportions with several salts which are formed by the oxyacids of nitrogen, sulphur, chlorine, bromine, and iodine with metallic oxides." We shall complete this too concise and consequently obscure description of the process by adding what is known respecting the preparation. The salts preferred by the author are the mercurous and mercuric nitrates. Aniline is carefully heated to about 150° C., and nitrate of mercury in powder is then dropped in, a small quantity at a time. A higher temperature than 150° must be avoided, or the action becomes too violent, and the colouring matter is destroyed. At every addition of the mercury salt a sort of ebullition is produced, the consequence of the reaction which takes place; metallic mercury is deposited at the bottom of the vessel, and the liquor gradually acquires a deep crimson colour. After being decanted, the whole is allowed to cool, and the colouring matter is now washed with a little water and dried. It is then freed from tarry matters by repeated washings with commercial benzine, and finally dissolved in alcohol or wood spirit, the solution being re-precipitated with water, &c., again and again until the product is sufficiently pure. Absolute purity is not necessary for either dyeing or printing.

Azaleine is soluble in water, but much less so than in alcohol. For dyeing silk and wool, alcoholic solutions are preferred; for printing on cotton, a dilute alcoholic is thickened with gum.

We have recently heard that the process now employed by M. Gerber-Keller is the following:—10 parts of aniline are heated on a water-bath to 100°, and 7 parts of mercuric nitrate, dry and in powder, are added by degrees. The mixture is maintained at the temperature of 100° for eight or nine hours, in which time the mass will have become of a magnificent violet-red colour. On cooling it forms a thick paste. The greater part of the reduced mercury is found at the bottom of the vessel. To employ the azaleine then produced as a dye or for printing, it is only necessary to treat the pasty mass with boiling water, a mixture of water and alcohol, acetic acid, or any other solvent, and make use of the solution.

The advantage of the last process consists in the moderate heat required, a high temperature seeming to cause the formation of tarry matters.

M. Albert Schlumberger has also described (*Bulletin de la Société Industrielle de Mulhouse*, March 1860, p. 170) a process for converting aniline into a red colouring matter by means of the neutral nitrate of mercury. He takes 100 parts of anhydrous aniline, and 60 parts of the nitrate of mercury, and heats the mixture to boiling. The mass slowly changes colour, at first becoming brown, but in time the whole is transformed into a beautiful red liquid. The operation is finished when the boiling materials are observed to swell up and disengage yellowish vapours. The mass so obtained is washed with two or three times its volume of boiling water, to remove the oils which are not completely metamorphosed, and then boiled two or three times with water to extract the colouring matter.

In this process, as well as in the preceding, the whole of the mercury is recovered.

In May, 1860, MM. Girard and Delaire obtained a patent for the use of arsenic acid in the preparation of a red colouring matter from aniline. They introduce into a distillatory apparatus 12 parts of dry arsenic acid and 12 parts of water. When the hydration of the arsenic acid is complete, they add 10 parts of aniline, and shake the whole well together. The mass becomes homogeneous, pasty, and almost solid. A gentle heat is then applied, so as to raise the temperature of the mixture gradually. The mass now becomes liquid. When the

[1] *Comptes-Rendus*, t. xlvii. p. 492.

operation is properly conducted, only water and a very small quantity of aniline distil. At 120° a great part of the aniline is changed into the colouring matter, and care must be taken to keep the mixture at this temperature for some time. The heat may then be increased, but it must never pass 160°. The operation lasts four or five hours.

In the above way a perfectly homogeneous mass is obtained, which is fluid above 100°. On cooling it solidifies, and has the appearance of a hard, brittle substance, with a bronze lustre. It is very soluble in water, to which it communicates a pure red colour, so deep that concentrated boiling solutions appear black. The solutions may be used for dyeing directly without fear, for the tissues will not retain a trace of the arsenic. If necessary, the arsenic may be easily removed from the colouring matter by one of the following processes:—

1. Powder the rough product and treat it with strong hydrochloric acid; then dilute with water, and saturate the clear solution with a slight excess of soda. The colouring matter is precipitated, while the arsenic remains in solution in the alkali, and it is only necessary to wash the precipitate once or twice with cold water to obtain the colouring matter quite pure.

2. The rough product dissolved in water is treated with a quantity of quick lime corresponding to the arsenical compounds it contains, *plus* a slight excess. The colouring matter is precipitated, as well as the arsenical compounds,—the latter in the form of insoluble calcareous salts. The liquor and the precipitate (unseparated) are now treated with carbonic, acetic, or tartaric acid, either of which will dissolve the colouring matter and leave the arsenic.

In this process aniline gives about its own weight of colouring matter.

The process of MM. Depouilly and Lauth, "for the manufacture of various coloured products derived from aniline," is very similar to that of Mr. Perkin. They take a solution of a salt of aniline and treat it with a solution of chloride of lime. The first drops of the chloride produce a violet coloration, and, on continuing the addition of the re-agent, a deep violet precipitate is formed, which constitutes the colouring matter. This is collected and washed with slightly acidulated water. When the washings are uncoloured, the precipitate is collected on a filter, and drained. It is then dissolved in a strong acid—sulphuric for example—and re-precipitated by the addition of a large quantity of water, or by an alkaline solution. The product is thus obtained sufficiently pure for sale. For dyeing and printing, alcoholic acid or aqueous solutions may be used, according to the nature of the article to be dyed and the purity of the colour required.

The next patents referred to by the author are those of Messrs. Beale and Kirkham, Mr. Kay, Mr. Price, and Mr. G. C. Williams, which have been already described in the Chemical News (Vol. i., pp. 9, 74, 81).

(To be continued.)

Experiments to Determine the Properties of some Mixtures of Cast Iron and Nickel, by William Fairbairn, *F.R.S.*

Some of my chemical friends in London had got an impression, from a careful analysis of meteoric iron, that it could be produced artificially by the combination of some of the same elements that were found to exist in the specimen analysed, containing about 2½ per cent. of nickel.

In order to determine whether it would be possible to obtain an artificial compound of this nature, and to ascertain the effect produced by mixing a certain proportion of nickel with cast iron, the following experiments were instituted. They consisted, in the first instance, in the extraction of the nickel from the ore which is found in the mines of the Duke of Argyle, near Inverary, in Scotland. The metal having then been purified by repeated meltings, was mixed with cast iron in such proportions as to form a compound, containing the same quantity of nickel as the specimen analysed. This was done by melting 2½ per cent. of nickel with carefully selected South Welsh cast iron from the works of Blaenavon and Pontypool. The mixtures were fused in crucibles, and run into ingots or bars, which were then tested in regard to their mechanical powers of resistance to a transverse strain.

This was done with great care, and the results which follow give unmistakeable evidence of the effects produced upon cast iron by an admixture of nickel, however small the quantity of the latter that may be introduced. Meteoric iron is, above all others, the most ductile, and it is recorded by travellers that the Esquimaux have instruments made from this description of iron so ductile that they may be made to bend round the arm. The ingots prepared on the occasion of these experiments were, however, widely different, as their power to resist impact was nearly one-half less than in those composed of pure iron.

It is uncertain what might have been the results had the castings produced been treated as cast steel, and hammered out until they were rendered malleable and magnetic. This process was not, however, attempted, as, judging from the appearance of the fracture, they were more likely to crumble under the hammer than attain malleability.

The nickel for these experiments was prepared from the ore, by fusing at a very high temperature in a crucible or steel pot,

30lbs. of roasted ore,
5lbs. of fine sand,
2lbs. of charcoal,
2lbs. of lime.

This mixture was kept in the furnace six hours, and then taken out and allowed to cool. The metal was then separated from the slag, and again melted with half its weight of roasted ore and one quarter its weight of green bottle glass ground to powder.

As before, the mixture was kept for six hours, at the temperature of a cast steel furnace. The metal had by the end of that time collected at the bottom of the crucible. It contained about 25 per cent. of nickel, and was of sufficient purity to be fused with cast iron. 10lbs. of it melted with 112lbs. of cast iron gave a mixture containing about 2½ per cent. of nickel.

The object of these fusings was to reduce the metallic oxide by means of the charcoal, while the lime and sand removed the oxide of iron, silica, sulphur and other impurities by forming a fusible slag.

Mixtures of nickel with cast iron (No. 1) and Blaenavon iron (No. 3) and Pontypool iron, each containing about 2½ per cent. of nickel, and also some pure Blaenavon cast iron (No. 1), were cast into bars about one inch square, and two feet six inches long, and subjected to the following experimental tests.

(A Table showing the breaking weight and deflections of the bars when subjected to a transverse strain is here

given in the original. Want of space obliges us to omit it. The results reduced from it are given in the following Table.)

Table I.—Results reduced to bars 1" square. Distance between the supports 2' 3".

	Breaking weight (b).	Ultimate deflection (d).	Power of resisting impact (b × d).	Strength compared with Blaenavon = 1000.
Experiment I. bar D. pure Blaenavon No. 3	1131	0·75	848·2	1000
Do. II. ,, C. Blaenavon No. 3 and nickel	875	0·58	507·5	773
Do. III. ,, B. pure cast iron No. 1	861	0·47	404·7	761
Do. IV. ,, A. cast iron No. 1 and nickel	637	0·434	276·4	563
Do. V. ,, E. Pontypool iron and pure nickel	798	0·366	292·1	705
Mean	860	0·52	465·7	760

From the above it is evident that an admixture of nickel in the proportion of 2½ per cent. does not increase, but diminish, the tenacity of cast iron. To what extent it might be improved by augmenting or lessening the proportion of nickel, a more extended series of experiments alone can determine. Mixtures of the two metals in the proportion used in the above experiments are decidedly inferior to the pure metal in their power of resistance to a transverse strain and to impact. In the first and second experiments on Blaenavon iron there is a loss of nearly one-fifth the strength; or the strength of the pure metal is to that of the mixture as 1000 : 773. And in Experiments III. and IV. with a more fluid iron there is about the same loss, the relative strengths being as 761 : 563; or as 1000 : 740. From these facts it is evident that nickel in the proportion of 2½ per cent. seriously injures the strength of cast iron, and moreover has injurious effects on its power of resisting impact, as the columns in the above Table indicating those properties clearly show.

It is difficult to account for the serious deterioration and loss of strength which the above experiments indicate. It may probably arise from the improper treatment of the nickel ore during its calcination and subsequent reduction in the crucible. When cast into ingots after the second melting the nickel had not the appearance of a pure metal, but exhibited a dull fracture, as if fine sand or particles of earth had been mixed with the crystals, showing the presence of impurities which it would be almost impossible to get rid of. It remained, therefore, a question for consideration whether the results would be different if nickel, properly prepared and of greater purity, were employed. To clear up doubts on this point a mixture of pure nickel with No. 3 Pontypool iron was made, but the result was a bar of white silvery metal, which broke when the weight of 798lbs. was laid on, as will be seen by referring to the Tables above.

I obtained from London a number of other bars, consisting of iron and nickel, which, on being submitted to the same tests as before, gave better results than those obtained in the previous experiments when nickel prepared from the ore was employed.

The results obtained from this second series of bars are given in the following Table:—[1]

1 The Table is omitted as before, the results alone being contained in the Table given.—Ed.

Table II.—Results reduced to bars 1" × 1". Distance between the supports 2' 3".

	Breaking weight (b).	Ultimate deflection (d).	Power of resisting impact (b × d).	Rates of strength Bar F 2 = 1000
Experiment VI. Bar F 1 without notches	867	0·315	273	1000 : 876
Do. VII. ,, F 2 do.	989	0·38	376	1000 : 1000
Do. VIII. ,, G 1 with one notch	760	0·331	251	1000 : 768
Do. IX. ,, G 2 do.	899	0·41	368	1000 : 908
Do. X. ,, H 1 with two notches	746	0·286	213	1000 : 754
Do. XI. ,, H 2 do.	703	0·29	203	1000 : 810
Mean	829	0·335	280	1000 : 838

I have been unable to ascertain the precise composition of these bars; but, assuming it to have been similar to that of the first series of bars, the greater powers of resistance shown by them would seem to indicate that the nickel employed in their preparation possessed a higher degree of purity than that used for the first series. Much, however, depends on the quality of the cast iron with which the nickel is mixed. The results derived from the foregoing experiments are conclusive, both in regard to those made on the first and those made on the second series of bars. Further experiments may, however, lead to different results; but, judging from what has already been done, I am inclined to believe that chemical combinations of a different nature are required, and probably a totally different process of manufacture will have to be adopted before a sufficiently strong and satisfactory compound can be obtained.

In attempting to ascertain the effect of a mixture of nickel with cast iron, the principal object was to determine to what extent the compound gave positive or negative results. It is well known that meteoric iron is peculiarly ductile, and it was assumed that nickel, added to cast iron in such proportion as to produce a compound similar to meteoric iron, would impart to it increased ductility. The foregoing experiments lead, however, to the conclusion that an admixture of nickel produces an exactly opposite effect, and it now remains to be determined, by a more extended series of experiments, whether by mixing nickel with malleable iron in the same relative proportion more satisfactory results would be obtained. In prosecuting these experiments it would be interesting to know the extent to which these metals are capable of combining chemically, and how closely such combinations would approximate to meteoric iron.

Besides endeavouring to obtain a metal of greater ductility, another object of equal importance was aimed at in these experiments, namely, to produce a metal of increased tenacity suitable for the casting of cannon and heavy ordnance. During the last two years innumerable experiments have been made for this purpose, with more or less success; but the ultimate result appears to be, that for the construction of heavy artillery there is no metal so well calculated to resist the explosion of gunpowder, as a perfectly homogeneous mass of the best and purest cast iron, when freed from sulphur and phosphorus.—*Memoirs of the Literary and Philosophical Society of Manchester*, vol. xv.

PHARMACY, TOXICOLOGY, &c.

Detection of Spots of Blood on a Rusty Instrument, by MM. Lesueur *and* Robin.

When it is necessary to distinguish between a spot of blood and a spot of rust, it may happen either that the spot is very minute or that it is occasioned by the superposition of blood and rust. In each case chemical reaction is of no avail. Robin and Lesueur have devised a method of recognising a portion of blood so small as hardly to form a film on the rusty instrument. With the help of a scalpel and a magnifying-glass, a small portion of the spot is scraped off into a drop of solution of sulphate of soda, made slightly alkaline by the addition of a little caustic soda, and is then examined under the microscope with a power of 520 diameters. At first the substance appears entirely homogeneous, but at the end of half-an-hour it swells considerably, and in another half-hour globules form, which can be disentangled by manipulating the glass slides one upon the other. These globules have been recognised as blood-discs of a mammal, and, consequently, human blood can be detected by the same process.—*Journal de Pharmacie et de Chimie*, t. xxxviii., p. 283.

On the Preparation of Black Oxide of Copper by the Humid Method.

This substance has long been employed in the manufacture of ophthalmic pomades. It is generally prepared by calcining nitrate of copper, but the following process, proposed by MM. Vogel and Reischauer, appears to us to yield a better product, and more suitable for a topical application to the eye—an organ so susceptible of irritation. Divide a solution of nitrate of copper into two equal parts; to one part add liquid ammonia, until the precipitate at first formed is re-dissolved. To this then pour the second part of the solution. This precipitates a blue basic salt; but sufficient ammonia remains in the solution, so that when boiled the basic salt is decomposed, and the precipitate converted into black oxide of copper. The liquid is easily boiled in a sand-bath, and the cupric oxide is speedily deposited. As the supernatant solution of nitrate of ammonia contains a little copper, it may be precipitated from it by the addition of a little sulphide of ammonium. The nitrate of ammonia is then very pure, and may be used for refrigerating mixtures.—*Revue Scientifique.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 13, 1860.

Dr. Fairbairn, *F.R.S. &c., Vice-President, in the Chair.*

The Chairman made some observations respecting experiments conducted in the Dukinfield Coal Pit, for the purpose of determining the rate of increase of temperature below the earth's surface. He stated that from these experiments a mean increase of one degree Fahrenheit for every seventy-one feet had been arrived at; and he promised on a future occasion to communicate the details of the determinations.

A Paper was read by Mr. Baxendell, F.R.A.S., entitled "On a System of Periodic Disturbances of Atmospheric Pressure in Europe and Northern Asia."

Whilst engaged, some time ago, in an investigation of the phenomena of the general disturbances of the atmosphere, the Author had been led to conclude that moderately accurate determinations of the sums of the oscillations of the barometer, for given periods, at different places on the surface of the earth, would afford valuable information respecting the nature of these disturbances, and, at the same time, throw additional light upon the causes by which they are produced. Determinations of the *statical* element of mean pressure are obviously of very limited use in an inquiry of this kind: but notwithstanding the importance of the subject, meteorologists have hitherto generally neglected to ascertain, even approximately, the values of the *dynamical* element as represented by the sums of the oscillations of the mercurial column. In none of the many volumes of observations which issue from the public observatories of this country and the Continent, has the Author yet seen any attempt made to deduce the values of this element.

Accurate absolute values of the barometric dynamical element can, of course, be obtained for those places only where hourly observations are made; but as it appeared to the Author that good comparative values would be quite sufficient for the general purpose of his inquiry, he decided to confine his attention, in the first instance, to oscillations derived from observations made once a-day only. By this plan the regular diurnal oscillations are completely eliminated; the results are adapted for very fair comparison with each other, and a greater number of sets of observations become available for the purposes of the inquiry. This method has accordingly been employed in the discussion of a very considerable number of observations made at various places in Europe and Asia, and a table is given showing the mean monthly and annual sums of the oscillations of the barometer at seven stations in Europe and six in Asia as derived from observations extending over periods varying from six to fifteen years. It is, however, remarked with reference to the results given for Greenwich, that as the individual observations of each day at Greenwich are not given in the published volumes, these results are derived from the daily means, and not from single daily observations, as in all the other cases. Diagrams of the curves laid down from the numbers in this table accompany the Paper. All these curves show a principal minimum in one of the three summer months, June, July, or August; and in many of them there is a second minimum in one of the two winter months, January or February. With respect to the two maxima which occur between these minima, it is shown that the interval between their summits gradually increases as we advance from the eastern to the western stations. Thus, at Nertchinsk (51° 19′ N., 119° 36′ E.), the first maximum occurs in the middle of April, and the second in the second week of November, the interval being nearly *seven* months; at Barnaoul (53° 20′ F., 83° 57′ E.) the first maximum takes place in the middle of March and the second in the middle of November, the interval being *eight* months; at Catherinbourg (56° 49′ N., 60° 35′ E.) the first maximum occurs in the second week of March and the second about the second week of December, the interval being *nine* months; at Tiflis (40° 42′ N., 44° 50′ E.) and at Lougan (48° 35′ N., 39° 20′ E.) the interval is also about *nine* months; at Stockholm, and also at Milan, the first maximum occurs in the middle of February and the second in the middle of December, the interval being *ten* months; but in the British Islands there is only one principal maximum, which occurs about the second week of January and which appears to be formed by the union of the first maximum of one year with the second maximum of the

year preceding, the interval between the two maxima being *twelve* months. It is evident, therefore, that these maxima move across the two continents in opposite directions, the course of the first being from west to east and that of the second from east to west.

As the apparently compound maximum of January is not greater than either of the separate maxima, the Author considers it very probable that both maxima are produced by the same disturbing cause, such disturbing cause taking its rise in Eastern Asia in the month of November, and gradually moving westward until it arrives in the British Islands in January; then reversing its course, it returns with a diminished velocity to the region of its origin, where it arrives in the month of April, and afterwards rapidly disappears under the influence of an increasing temperature, to re-appear later in the year on the return of a low temperature.

As the times of first appearance and of final disappearance of the disturbing cause in Eastern and Central Asia, correspond very nearly with the times of the breaking up of the monsoons in the China Sea and Indian Ocean, it is considered very probable that the two systems of phenomena are directly connected with, and dependent upon, each other.

Attention is drawn to a very decided convexity of nearly all the curves in the month of October, indicating the operation of a secondary disturbing cause acting during that month over the whole breadth of the two continents.

In concluding, the Author remarks that the first application of the method he has employed appears to be due to Dr. Dalton, and that the only other application of it which he has yet met with is in Mr. Broun's very able discussion of the Makerstoun observations.

At the conclusion of the Paper, Mr. Robert Worthington expressed the high opinion which he entertained of the importance and value of the observations brought forward by Mr. Baxendell, as forming a new step in the method of discussion of the disturbances of atmospheric pressure in which a definite mode of measurement was adopted. He knew, from his own experience, how laborious such an investigation was, involving as it did, many scores of thousands of numerical operations. It was important to understand that the observations used by Mr. Baxendell were those published by some recognised meteorological institution.

The Chairman remarked that the Paper just read afforded striking proof of the great value of the Society's library of reference, which was fast becoming one of the most complete in the country. Without the help of the library the collection and arrangement of all these observations would have been impossible; and he strongly urged the members to assist in rendering more effective so important a part of the Institution.

SOCIETY OF ARTS.

Wednesday, November 21, 1860.

At this, the opening meeting of the present session, Sir Thomas Phillips, F.G.S. (Chairman of the Council), delivered his Inaugural Address to the members of the Society of Arts, among whom Messrs. C. Wentworth Dilke, V.P., G. C. Bodkin (Assistant Judge), Sir C. Rowney, John Dillon, V.P., G. G. Frith, Thomas Winkworth, Glenny Cole, C.B., W. Howes, S. Redgrave, and many other distinguished gentlemen were present.

Sir T. Phillips commenced by alluding to the compliment paid to him by the Council in again electing him their chairman, and next referred to the losses sustained by the Society during the past year through the death of several eminent members. Of these, Matthew Uzielli, who was the first to guarantee 10,000*l.* for the proposed International Exhibition in 1862, Sir William Ross, R.A., A. E. Chalon, R.A., Peter W. Fry (of photographic celebrity), Earl Cawdor, Henry Bradbury, Professor Baden Powell, and Dr. Buist, of Bombay, had all passed away within a very brief period, and were each briefly noticed by the Chairman in their turn. He then announced that Dr. Cantor, of Her Majesty's Indian Medical Service, had bequeathed property of the approximate value of 9000*l.* to the Society of Arts and the Wellington College, in equal shares. Dr. Cantor had never been a member of the Society; and it was very gratifying to learn that their proceedings had awakened the interest and sympathy of their countrymen in far distant lands. An account of the steps taken by the Council to promote the intended Exhibition, was next given, with the leading arrangements of which our readers are probably acquainted. The trustees recommended are—Earl Granville, K.G., Lord President of the Council; the Marquis of Chandos; T. Baring, Esq., M.P.; C. W. Dilke, and Thomas Fairbairn, Esqs. Although no public meeting has been held, nor advertisement issued, no less than 661 noblemen and gentlemen have recorded their names as guarantees for an aggregate sum of 365,800*l.* The Chairman then proceeded to review the past proceedings of the Society, which, he said, had doubled its members within ten, and quadrupled them in the last fifteen years, while the number of candidates proposed for election on that occasion was larger than at any previous meeting, amounting to upwards of 100.

The medals awarded by the Council during the past Session were then presented in the following order:—

To Mr. R. Thomson, for several novel and ingenious instruments and tools for use in Dental Surgery: the Society's silver medal.

To Mr. Leonard Wray, for his compound of materials as a substitute for gutta percha: the Society's silver medal.

To Mr. J. C. Morton, for his paper read before the Society, "On the Forces used in Agriculture:" the Society's silver medal.

To Mr. Leonard Wray, for his paper read before the Society, "On the Means of increasing the Production of Sheep's Wool and Angora Goat's Hair:" the Society's silver medal.

To Mr. George R. Burnell, for his two papers read before the Society, "On Building-stones—the Causes of their Decay and the Means of Preventing it," and "On Building Woods—the Causes of their Decay, and the Means of Preventing it:" the Society's silver medal.

To Dr. Dauglish, for his paper read before the Society, "On a New System of Bread Manufacture:" the Society's silver medal.

To Dr. J. Forbes Watson, F.R.S., for his paper read before the Society, "On the Chief Fibre-Yielding Plants of India:" the Society's silver medal.

After a cordial vote of thanks to Sir Thomas Phillips, for his able address, the Secretary announced that the following papers would be read at the meetings previous to Christmas:—

November 28.—"On the Acclimatization of Animals." By Mr. F. T. Buckland, M.A., Student of Christ Church, Oxford, Assistant Surgeon, Second Life Guards.

December 5.—"On Electro-Block Printing, especially as applied to Enlarging or Reducing from any Printing Surface or Original Drawing." By Mr. H. G. Collins.

December 12.—"On Italian Commerce and Industries." By Professor Leone Levi.

December 19.—"On the Straw-Plait Trade." By Mr. A. J. Tansley.

The Society then adjourned till Wednesday evening, November 28.

Royal Institution.—The General Monthly Meeting will be held on Monday, December 3, at two o'clock p.m.

NOTICES OF BOOKS, PATENTS, &c.

Preparation of Bones for Manure. W. Aristides Vérel, of Macduff, County of Banff. Dated 22nd August, 1859

The patentee claims the combination of a riddle or sifter with a fan or blowing apparatus, for the purpose of separating those parts of the crushed bones, which, from their porosity, decompose easily; from those solid and heavy particles which, owing to their hardness, will resist decay for a long period: and also for separating the iron contained in the bones.

When bones pass through a crushing-mill, much of the product is already in a sufficiently fine state to be used economically for manure without any further treatment. The sifter and fan remove this portion, and separate the somewhat considerable quantity of pieces of iron nearly always present. The separated portion is also well adapted for making superphosphate of lime.

Preparation and Bottling of Cod-liver Oil, &c. Sir James Murray, of Dublin, M.D. Dated 24th August, 1859,

This patent is for filling the bottles intended to contain aërated cod-liver oil, &c., with carbonic acid. This is done by the patentee by the process of displacement. His claims are,—1st. The revivifying of the aërated liquids after having been already prepared in the ordinary manner, by repeating the process or processes of aëration after the liquids have been fined, and just before they are bottled, under such pressure as to secure an excess of fixed air, in order to preserve them in a better condition than those hitherto in ordinary use. 2ndly. The preparation of the bottles, by displacing from them the ordinary atmospheric air with any impure vapours, miasms, or gases therein contained, and replacing it by an atmosphere of carbonic acid gas. 3rdly, The bottling of the liquids in vessels containing an atmosphere of carbonic acid gas, that being the gas already in the re-carbonated liquor or liquors. And, lastly, the preparation of the corks, by withdrawing from them the ordinary atmospheric air with its impure vapours or gases, and causing some of the liquors intended to be bottled to enter their pores and saturate them.

To speak of the "impure vapours, miasms," etc., in the air contained in an ordinary bottle or cork, as substances requiring removal, is simply absurd. The substitution of an atmosphere of carbonic acid for one of air is, however, an idea capable of being applied to more important uses than the preservation of "aërated cod-liver oil."

Manufacture of Starch and Compounds of Starch, and extracting Gum, Dextrine and Grape-Sugar therefrom. Wilhelm Adolf Von Kanig, of Hardinge Street, Islington.

Chemists are aware that chlorine, in presence of water, produces oxidation of starchy bodies, even to the extent of converting them into carbonic acid and water, and that even the hypochlorites are capable of producing the same reaction if assisted by a temperature of 212°. But the patentee by using the same re-agents in a highly-diluted form converts sago into soluble starch, and is thereby enabled economically to use that substance as a source of gum, dextrine, and grape-sugar. The patentee consequently claims the use of chlorine for converting insoluble into soluble starch, and also for removing gluten from starch. The following is a condensed account of the process of maufacture:—The crude materials, such as sago, wheat, rice, barley, oats, millet, rye, maize, buckwheat, peas, beans, potatoes, tapioca, mandioca, etc., are first steeped in water, or in a weak solution of chlorine, and, after crushing, are mixed with a solution of chloride of lime (one pound of the re-agent to three gallons of water), after three hours' steeping with constant agitation, the starch is to be removed from the pulp in the usual manner. The product is washed with cold water until the latter comes away quite clear. The starch so obtained is soluble in boiling water.

CORRESPONDENCE.

The Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—When a man observes a class of occurrences to take place, the question naturally arises: "Why?" If they can be proved inevitable from previously known facts, they are said to be satisfactorily accounted for. But if, on the other hand, no previously acquired knowledge be sufficient to explain them, we are obliged to invent a hypothesis that will. This hypothesis has now to be proved true or false. If true, of course the question is settled, the hypothesis proved a fact, and the phenomena satisfactorily accounted for.

But if the hypothesis be proved false, we must invent another and another, until we find one that can be proved true.

Thus far "Ultimatum" will agree with me. Certain facts have been observed, and they have been accounted for by the atomic theory. So far so good,—it now remains for us to prove whether it be a true or a false one.

"Ultimatum" thinks it has been already proved a fact, for he says the proofs are so well known that they do not require recapitulation. However, I shall feel obliged if he will give a proof of the existence of indivisible atoms; for as yet I have heard none but those which have been refuted by the opposite party.

As "Ultimatum" says he can prove the existence of atoms, and refute my proofs of their non-existence, it will be wise for me to wait before taking it as proved, as a last step, that atoms do not exist.

"Ultimatum" will excuse me, when I say that I think he has misunderstood some portions of my last letter. By saying that I reason in a "naked-eyed and finger-touch fashion," one would suppose that I disapproved of hypothesis, which I do not. What I disapprove of is this: that hypothesis should be set down as facts so quickly, before they have undergone a sufficiently careful examination. Again, his insinuation that I indulge in "paper and ink dogmas," would lead one to imagine that I am attempting to propound a new theory. I do not even profess to do so, and that is the reason why I have not supplied "a satisfactory explanation of phenomena which were hitherto thought to be explained by the old theory."

At present I have only examined the old hypothesis; the invention of a successor I leave to wiser heads than mine, if, perchance "Ultimatum's" arguments be found, like the rest, not proofs, but mistaken attempts.

I am, &c.

Thomas S. Barrett.

On the Homogenesis of Forces.

To the Editor of the Chemical News.

Sir,—I do not quite agree with the author of the paper in your Number for Nov. 27, "On the Homogenesis of Forces," when he says, all the phenomena of the universe are caused by *matter in motion*; for, let us suppose six forces, a, b, c, d, e, f. Now, if we can prove that a can produce b, and of b, c, d, e, f any one is capable of producing the remaining four, but is unable to produce a, then, it is evident, we may consider a the elemental force, from which, so to speak, the other five take their rise.

In connection with the universe there are six forces,—Gravitation, Motion, Light, Heat, Electricity, Chemical Affinity. We know that gravitation produces motion, and gravitation is a force that cannot be generated; for it only comes into existence when matter is created. We have remaining, Motion, Light, Electricity, and Chemical Affinity.

MATTER IN MOTION PRODUCES

Light—As we see by the rubbing together of two pieces of quartz.

Heat—By the friction of two bodies, such as two pieces of wood.

Electricity—In the common electrical machine, and in hydro-electric engine, the glass and steam being the matter in motion.

Chemical Affinity—As when a piece of flint is struck by steel, and the minute particles of the latter rubbed off, combine with the oxygen of the air.

LIGHT PRODUCES

Electricity—For a needle placed in a certain part of the prismatic spectrum becomes after a time magnetic.

Chemical Affinity—Hydrogen and chlorine if mixed combine when exposed to the light.

Motion—Light decomposes many solutions, and, the arrangement of the atoms being altered, motion is produced.

Heat—I do not know whether light actually generates heat; at all events, it does through the agency of electricity, for we shall afterwards see that electricity produces heat, and, from the above, we know light generates electricity: therefore, indirectly, light can produce heat.

HEAT PRODUCES

Motion—During the expansion of a body, the particles being driven further asunder; motion of necessity is generated.

Light—Bodies when heated to a certain temperature become luminous.

Electricity—The tourmaline when heated becomes electric, and the thermo-electric pile is another example.

Chemical Affinity—Sulphur and iron, for instance, will not unite in the cold, but if heated they readily combine.

ELECTRICITY PRODUCES

Motion—By attraction and by decomposition; for when a molecule of water is decomposed into an atom of oxygen and an atom of hydrogen motion of the atoms is produced.

Heat—By the passage of the electric spark from one body to another, and of the current through a wire of not sufficient thickness to conduct it readily.

Light—By the discharge from one conductor to another.

Chemical Affinity—For by passing a succession of sparks through atmospheric air, the nitrogen and oxygen combine, forming several oxides of nitrogen.

CHEMICAL AFFINITY PRODUCES

Motion—Take as an example a double decomposition, as when chloride of barium is added to sulphate of soda, motion of the particles must ensue in the interchange.

Light—As when oxygen and hydrogen, or phosphorus and iodine, combine.

Heat—By the combination of water with sulphuric acid.

Electricity—As is seen in the action of dilute acids on dissimilar metals.

From the above examples, which are known to everyone, we see that

Motion produces light, heat, electricity, chemical affinity.

Light produces motion, heat, electricity, chemical affinity.

Heat produces motion, light, electricity, chemical affinity.

Electricity produces motion, light, heat, chemical affinity.

Chemical Affinity produces motion, light, heat, electricity.

Any force producing one of the above could, through the influence of that one, produce the remaining four, and if it could not be itself generated would be the elemental force.

Now, *Gravitation* cannot be generated, but it produces motion, and, therefore, produces light, heat, electricity, and chemical affinity, through the medium of motion; hence I think if the causation of all the phenomena of the universe be referred to one force, it must be to gravitation, not to "matter in motion."—I am, &c.

GEORGE F. RODWELL.

Specimen Exchange Club.

To the Editor of the CHEMICAL NEWS.

SIR,—For some time back there have appeared in the CHEMICAL NEWS communications relative to the advantage and profit likely to be derived from an exchange on the part of chemists of different chemical preparations; but is it not possible for such preparations to find their way into the hands of parties having no equivalent to offer but money, who, nevertheless, ardently desire to have such preparations at their command, and the possession of which on their part would, in my opinion, do much towards the perfecting of the manufactures of our country? In one of your recent impressions, notice was taken of the field open to the discovery of uses for substances long known to the chemist; and aniline, among others, cited as an instance. This is most undoubtedly true, and who so likely to find a practical use for any substance as a practical man (I allude, of course, to minor applications); the very one who cannot experiment on such substances at present. This may be a wrong idea, and an impracticable one, but still, as I find many things noticed which I should like to experiment with, but am unable to prepare, and am obliged to do without, it struck me, that by communicating my ideas through the medium of the CHEMICAL NEWS some such movement might be brought about productive of good results.—I am, &c.

PRACTICE.

The Adulteration of Food Bill.

To the Editor of the CHEMICAL NEWS.

SIR,—There is one point in the Adulteration of Food and Drink Bill that appears to have escaped your legal acumen, and which will most probably prove to be a piece of interesting information to many of your readers, viz., that it can only be applied in towns and cities having a separate Quarter Sessions. This, more than anything else, exemplifies the delusive character of this specimen of legislative wisdom. It is scarcely necessary to remark that the effect of this is to confine the benefits of the Act to a very small portion of the populous towns of England.

—I am, &c. J. M. RIMMINGTON.

Bradford, Yorkshire.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Ozone in the Mineral Kingdom.—There is blackish-violet coloured fluorspar, found at Wölsendorf, which, on being rubbed with a hard body, emits the odour of ozone. That the smell really belongs to ozone Schrötter (*Sitzungsber. der Akad. de W. zu Wien*, Bd. xli.) has satisfactorily determined. When the mineral is rubbed in an agate mortar with a solution of starch and iodide of potassium, the blue colour is immediately produced: and if the mineral be rubbed in the mortar dry, and a strip of ozone paper be held over, the reaction is seen directly. When the mineral is rubbed with water, a

smell is evolved, which strongly resembles that of ozone, but at the same time calls to mind the odour of hypochlorous acid. The water filtered from the mineral turns the iodide of potassium and starch solution blue. When the fluorspar is rubbed with a solution of pure carbonate of potash, a stronger smell is given off, which much more resembles hypochlorous acid than ozone. The author, however, proves that the reactions are really due to ozone, and not to a chlorine compound. He found that when the mineral was gently heated, the smell was emitted; and that on stronger heating the odour ceased, while the dark blue colour of the mineral changed to a pale red. He then heated the fluorspar in a combustion tube, and passed slowly a stream of atmospheric air, which was afterwards led over fragments of porcelain heated to strong redness, and then passed into a solution of starch and iodide of potassium. If now the mineral only contained ozone, the latter would be destroyed by passing over the red-hot porcelain, and no blue colour would be produced; and if hypochlorous acid were present it would be decomposed, and the chlorine set free would give the blue colouration. The result showed that only ozone was present, for on removing the starch solution (which was unaffected), and making the air to pass through a solution of nitrate of silver, no trace of the chloride was obtained. The author afterwards estimated the amount of ozone in several specimens, and gives 0·02 per cent. as the maximum contained in the fluorspar of Wölsendorf. He also found that on passing a stream of strongly ozonised air over a specimen, the fluorspar was able to absorb more ozone.

II. ORGANIC CHEMISTRY.

Transformation of Amylaceous Matter into Glucose and Dextrine.—Musculus is of opinion (*Annales de Chimie et de Physique*, t. lx. p. 203) that the formation of dextrine and glucose is the result of a complete decomposition of the amylaceous matter, and not simply a molecular modification with the assimilation of water. The author's researches on this subject have shown him—1, that diastase has no action on dextrine; and 2, that the dextrine and glucose appear simultaneously when starch is acted on by diastase or dilute sulphuric acid, and always in the same proportions—viz. one of glucose and two of dextrine. He shows that dilute sulphuric acid acts at first, exactly like diastase, but is distinguished by this, that the reaction continues after the starch has disappeared. When starch and the dilute acid are boiled together, the amount of glucose increases rapidly until the liquor no longer turns blue with iodine. At that moment there is in solution a mixture of dextrine and glucose in the proportion of 2 : 1, just as if diastase had been employed. In the latter case no further change is produced; but in the former the amount of glucose is slowly increased by continued boiling. Now, if glucose be produced by the simple hydration of dextrine, the author cannot understand how it is that the glucose is formed more rapidly while starch is present in the liquor, than when only dextrine remains; the contrary, he thinks, ought to happen. The practical conclusions which the author draws from his experiments are important, and we give them at length:—1. In the manufacture of glucose, where the reaction is supposed to be finished, when the solution no longer turns blue with iodine, and no precipitate is produced by alcohol, a large quantity of dextrine remains mixed with the glucose, and as the former does not ferment with yeast, there is a great loss to the consumer. Manufacturers, therefore, if they wish to ensure a good product, must employ a higher temperature by boiling under pressure, and boil for a longer time. 2. The great resistance which dextrine opposes to the action of dilute sulphuric acid, furnishes a ready means of estimating a mixture of cane sugar and dextrine; a minute's boiling is sufficient to modify all the sugar, so that it may be estimated by the cupro-potassic tartrate, while the dextrine undergoes no change. 3. The limited action of diastase explains how it is that brewers are obliged to employ so large a quantity of barley to produce a liquor with so little alcohol, two-thirds of the starch passing into the beer in the form of dextrine. And 4. That, in the manufacture of spirit from corn, there is an inevitable loss of two-thirds.

Production of Fuchsine.—Schlumberger (*Dingler's Polytech. Journal*, Bd. clvii. s. 292) says that a mixture of protochloride of mercury and tin amalgam, which forms anhydrous chloride of tin, offers a ready means of changing aniline into fuchsine.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, the 6th instant, at eight p.m.

Pharmaceutical Society.—The next meeting of this Society will take place on Wednesday, December 8, when the following papers will be read:—"On Glycerine, and Some of its Applications," "On Spermaceti Ointment and Bleached Olive Oil," by Mr. J. B. Barnes; "On the Process of Displacement," by Mr. J. W. Sandford.

The Deadly Effects of Arsenic in Paper-hangings.—Among the well-authenticated instances of the appearance of apparitions is one which runs very much to the following effect:—An old man and woman had gone to church one Sunday morning, leaving a son at home, who was more studious than pious, and a servant-maid to prepare the dinner. While the young man was sitting reading, he became aware of the presence of a venerable old man, who sighed deeply, and directed him to turn to a certain chapter in the Bible and read it aloud. He did so, and when he came to the words "And the prophet said, There is death in the pot!" the old man rose and said, "Yes; there is death in the pot. The servant has put arsenic in it," and immediately he disappeared. The young man was considerably alarmed by the suddenness of his disappearance, but he did not disregard the warning. He took a small portion of the porridge from the pot and gave it to a dog, and in a short time the animal was dead. If, in the present day, a spirit appeared every time the pot contained arsenic, the mediums would seldom find spirits at their *séances*; they would be too much occupied elsewhere. We find arsenic in our flour, in our cheese, our vegetables, and, in fact, it would be difficult to say where it cannot be found; but, worst of all, it is only too commonly present in the very air we breathe. On this point we can now speak positively of our own knowledge. Several of the bedrooms in our house happen to be covered with that pleasing-looking, but fatal, paper which owes its treacherous beauty to Scheele's green, or arsenite of copper. A constant soreness of the throat which seemed to have settled itself upon those members of our family who were in the habit of sleeping in these arsenical rooms, made us determined to investigate the green paper-hangings; and, having collected three and a-half grains of dust from the top of a wardrobe, we subjected it to an examination for arsenic. The test used was Reinsch's; every precaution being taken to prevent the possibility of error in the result. After boiling for a few seconds, the copper became of a dark steel-colour, and the subsequent operations being completed we obtained a comparatively large quantity of arsenious acid, in the form of octahedral crystals. This, considering the small quantity of material analysed, appears sufficiently alarming; but if, instead of taking dust from a surface in close proximity to the ceiling, we had collected it from the floor behind the wardrobe, there is no doubt the quantity of arsenious acid obtained would have been much larger, but would have given a

more correct idea of the extent to which it impregnated the atmosphere, since the particles of arsenite of copper have a great tendency to fall towards the earth, from their high specific gravity. Whatever doubt we may have hitherto felt on the subject of the danger of living or sleeping in rooms the walls of which were covered with green paper, is now set at rest, and we are satisfied that the irritation of the mucous membrane of the throats, which we and other persons who slept in these rooms continually complained of, arose from inhaling an atmosphere contaminated with particles of arsenic: this, also, is the opinion of an eminent physician whom we have consulted on the matter. To make assurance doubly sure, we stripped a small portion of the green paper from the wall and scraped off the colouring matter; this being analysed, yielded crystals of arsenious acid in abundance. We have since subjected several specimens of similarly-coloured paper-hangings to the same test, and always with a like result; but there was one especial instance in which the quantity of arsenious acid obtained was so large that we are quite sure no person, however strongly constituted, could have lived in a room hung with such paper, without being seriously, if not fatally, affected by it. The paper from which this was obtained was a rich-looking, green flock-paper, remarkably pleasing to the eye, and therefore extensively used. It was not necessary to scrape the surface to get the colouring matter off, lightly brushing it two or three times was quite sufficient to remove as much as was requisite for analysis; and we have no hesitation in saying that the mechanical attrition of a lady's dress brushing past the wall would of itself be sufficient to remove a tangible portion of the arsenite of copper from such paper as this, and that the action of the housemaid's broom would liberate a quantity sufficient to poison a man if he inhaled the whole of it at one sitting. Fortunately for the generality of men whose rooms are covered with this paper, they do not remain long enough in them to suffer much from it; but how often might the languid, ailing state of their wives or grown-up daughters be traced to this cause? They have no positive disease to account for it: the doctor prescribes, but, of course, his prescriptions are of no use while the cause remains the same. It is commonly supposed that arsenic accumulates in the body when taken in minute doses, and that inasmuch as people swallow it daily in the water they drink in one part of the world, and take it in the form of a powder in another part, without appearing to suffer from it, there cannot be much harm in inhaling it in such minute quantities. In the first place we believe it is not the case that the arsenic remains in the system; and in the next place there is all the difference in the world between taking certain poisons into the stomach, and bringing them into direct contact with the blood. There are poisons which are perfectly harmless in the first case, but are most deadly in the second. But facts are more convincing than any amount of theory; and in support of what we have stated we may mention the following case:—A Mr. T. King, living at Highbury, had a little son three years and a-half old, and a daughter still younger. The breakfast-room was hung with green flock paper, and in this same room was a cupboard in which they kept toys and other things. A few days ago they cleared out this cupboard, and the little boy was noticed to put a piece of lace he found there into his mouth and suck it. Not long after this he was sick, unable to eat, and speedily sank into a semi-comatose condition, which was only broken occasionally by violent convulsions, and he died in about thirty-six hours. In the meantime his sister had been seized with similar symptoms; and as this was the second time they had been attacked simultaneously, it naturally occurred to the doctor that the cause of decease was not a natural one; he, therefore, sent portions of the body to Dr. Letheby, to be analysed; and the result was, that he discovered arsenic in the stomach, the liver, and the evacuations. A piece of the green paper was also sent to him to be tested, and he found that one-third of its weight was arsenite of copper. An inquest was held on the body, and the verdict returned by the jury was, "That Clarence William King had been poisoned by the inhalation of arsenical fumes which had escaped from the green paper of a certain sitting-room, and that the manufacturer of such paper had been guilty of very careless and culpable conduct." We are disposed to think that the verdict of the jury is much too positive as to the means by which the arsenic entered the body, but that is more a question for medical men than chemists. As to the concluding portion of the verdict, it seems to us that the man who made and sold such paper was guilty of something more than careless conduct. To say that he did not know that the colouring matter of the paper was of such a deadly character would be absurd; there is not a maker of such pigments, in England or anywhere else, who is not perfectly well aware of the injury they are capable of doing to the health of individuals. The fact is, Scheele's green, as the arsenite of copper is termed, is not only cheap, but produces a green of peculiar brilliancy. The public, for the most part, knowing nothing of the danger of covering their rooms with such paper, give it the preference over that of a duller tint; consequently, there is a great demand for this paper, which, so long as it lasts, the manufacturer will continue to supply, utterly regardless of results. The time which Parliament occupies in remedying an abuse, even when it can be induced to take it in hand, is so long, that we are not very sanguine of help from that quarter; but if the press generally makes the facts we have stated known to the public, it will be the fault of individuals if they suffer themselves to be poisoned in this way any longer.

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A Well-wisher shall receive a reply by letter, if he will favour us with an address.

J. A. D.—The demands upon our space have now become so numerous that we are reluctantly compelled to decline inserting some contributions, in order to make room for matter which will be more likely to interest the general reader.

Acetate of Soda.—The correspondent who wrote on this subject a week or two ago, can hear of a purchaser if he will forward his address to us.

A Reader.—The proposition you make has already been in contemplation for some time, and will, if possible, be shortly carried out.

Book Received.—"The Laboratory of Chemical Wonders," by G. W. Septimus Piesse. Longmans.

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THE CHEMICAL NEWS.

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THE ADULTERATION OF FOOD ACT IN THE CITY.

ONE of the best abused Corporations in the world is that of the City of London,—wherefore, it would be difficult to say, seeing that it has, on almost every occasion, shown itself ready to adopt improvements in the administration of municipal laws, and to accept the Acts of the Legislature affecting Corporations, even when, by its charter, it is exempt from their compulsory application. The Adulteration of Food Act is one of those enactments which the City of London might have suffered to remain a dead letter if the Corporation had so pleased; indeed, if it had done so, it would only have acted like too many of the parishes of London in which the population is far greater than in the City. But the regard for the public health, and the responsibility of those to whom its preservation is entrusted, seem to be better understood within the City boundaries than outside them. The selection of Dr. Letheby to fill the post of Public Analyst within the limits of the corporate jurisdiction, is one of those instances in which the doctrine of "the right man in the right place" is eminently illustrated, and the appointment is one that does credit to those who made it. The first report made by the Doctor, in his capacity of Food Analyst for the City, has been addressed to the authorities by him within the last few days. It is not a statement of what he has done in pursuance of the Act, but what he thinks ought to be done, and what he proposes to do. He considers that two classes of adulteration are aimed at by the Act—that in which the adulterating agent is injurious to the health of persons swallowing it, and that in which it cannot be shown to be injurious to health, but only to the purses of the purchasers. He gives as examples of the former the colouring of confectionery with poisonous pigments, the admixture of red lead with Cayenne pepper and curry powder, chromate of lead in custard powders, &c.; and, in the latter class, the addition of cheap starches to arrow-root, chicory to coffee, and a host of other things. He then enumerates sundry other adulterations which he conceives to occupy an intermediate place between the classes above specified, being an undoubted fraud, and, at the same time, possibly injurious to the public health, as, for instance, the addition of alum or sulphate of copper to bread, sulphuric acid to vinegar, plaster of Paris and chalk to sweetmeats, and so forth. The distinction is one without any very obvious difference; the use of these substances, in the manner indicated, is an unquestionable fraud, and is certainly injurious to health if taken in a sufficient quantity. We need not follow the Doctor in his description of the mode in which the Act is intended to operate, nor in what he says with respect to its provisions, a very complete analysis of it having been given at the time it was introduced into Parliament (*Vide* CHEMICAL NEWS, Vol. I., p. 122); but the alterations which he suggests, coming from so high an authority, are deserving of more consideration and remark. According to the Act, any person buying an article which he desires to have analysed, may require a Public Analyst to analyse it, on payment of a fee of not less than 2s. 6d., nor more than 10s. 6d.; but it appears to have contemplated that the Analyst would be in the receipt of a fixed salary in virtue of his office. Dr. Letheby is of opinion that the lower sum specified would be insufficient; and he suggests that an intermediate sum, 5s., should be fixed as the fee in all cases, which, he considers, would prove that the object of making any charge at all is to prevent tradesmen from being annoyed by groundless complaints.

Of course it is hardly necessary that we should point out that, unless the Analyst be paid a fixed salary, such a sum as that suggested would be altogether inadequate to secure the services of a chemist of any ability. The article which he would, in all probability, be called upon to analyse most frequently would be bread, and the detection in it of alum—the substance most commonly used in adulterating it,—being one of the most difficult problems in the whole range of inorganic chemical analysis, could only be accomplished by a master in his profession; so that unless the remuneration be sufficient to induce such a man to sacrifice his time, the post of Public Analyst will be filled by incompetent persons, thus causing endless confusion and litigation, besides casting a slur on the profession of Chemistry itself. Dr. Letheby recognises the inability of the poor to pay even a fee of 5s.,—and he might also have added, that if the fee were only 6d. they would prefer to take their chance of being poisoned rather than pay it,—and he therefore proposes that a discretionary power should be given to the analyst to make such analyses for the poor without fee. The complaint must come from a poor person in the first instance, who must deposit the suspected substance, with full information, at the Analyst's office, and then, if he thinks the matter serious enough, he shall direct the inspector to purchase a sample of the article at the shop named, and analyse it free of charge. In making this suggestion, Dr. Letheby is addressing only the City authorities; but, if it be adopted by them, the influence which their course of conduct exercises over similar bodies will probably lead to its adoption elsewhere. This method of meeting one of the objections to the Act does not appear to us satisfactory, and it would be far better not to attempt to amend it in detail, by means of palliatives, but rather to point out fully all its defects, with a view to a general amendment of the Act in the next session of Parliament. In law-making we do not think it an advisable course of proceeding to leave anything to the discretion of individuals. Dr. Letheby would, no doubt, thoroughly carry out his own idea, notwithstanding the incessant demands made upon his time by other business; but, among several hundred analysts, it would show an ignorance of human nature to suppose that they would all neglect analyses for which a good fee would be paid

in order to analyse poor Smith's loaf or Jones's sample of coffee.

Looked at from any point of view, this part of the Act requires alteration if it is to be effectual in protecting the public, and we still adhere to the opinion we expressed on this subject some months ago, viz., that, in the interest of the public, it would be better to remunerate the Analyst by allowing him a certain proportion of the fine inflicted by the Justices, and leave it to him to make as many purchases and analyses as he pleased. Such an arrangement would not be that most agreeable to chemists appointed to the post of Public Analyst, but, after all, they have as much public spirit as other men, and would not hesitate to make some sacrifice in the interest of their fellow-citizens. At all events, such a plan would offer the best guarantee to the Legislature of the carrying out of their intentions,—so far, indeed, as they have manifested any in the concoction of the mild affair styled the Adulteration of Food Act.

The most important feature in Dr. Letheby's report is the intention he expresses of making a return to the Commissioners of the analyses made, the result, the name of the vendor of the article, &c., in his quarterly report, thus insuring a certain degree of exposure, if it does nothing else. As regards the prosecution of the offenders, the power rests in the hands of those who are little likely to enforce it, and whom it would be almost absurd to expect to do so.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Quantitative Determination of Metals when Precipitated as Sulphides, by M. H. Rose.

In analytical researches most metals are precipitated from their solutions as sulphides, either by sulphide of ammonium or by sulphuretted hydrogen; nevertheless, they are rarely weighed under this form, but are generally first brought to the state of oxide by long and tedious operations. M. Rose proposes to replace these operations by weighing the metals in the state of sulphide when this is possible.

M. Rivot has already pointed out this simplification in the case of copper, which he transforms into sulphide, Cu_2S by calcining the dry precipitated sulphide with flowers of sulphur. The weight of the copper thus obtained is a little too great. According to M. Rose, the result is more exact when the calcination is performed in a current of dry hydrogen, introduced by the aid of a porcelain or platinum tube at the bottom of the crucible containing the mixture of sulphide of copper and sulphur. The crucible is provided with a cover with a hole in it, which gives passage to the tube. Heat should not be applied to the crucible until the whole apparatus is full of hydrogen, and it is indispensable to continue the disengagement of the gas until the crucible is quite cold. The same process is applicable to the quantitive estimation of various other metals.

Manganese.—Manganese is often precipitated in the state of sulphide, although this is not wholly insoluble, especially in liquids containing salts of ammonia, and deposits itself very slowly. The sulphide once obtained it is easily weighed, by proceeding in the same manner as for copper. The filter is previously burnt separately, and put into the crucible already containing the dry sulphide mixed with sulphur. The oxidation of sulphide of manganese whilst exposed to the air during washing and desiccation has no effect on the result; at the bottom of the crucible a mass of sulphide, MnS, is always found, which is green when not much heated, and black (the powder being green), like the native sulphide, when made red-hot. Manganese is frequently weighed in the state of anhydrous sulphate, but this process is rather uncertain, because it is difficult to drive off all the water without at the same time losing a small quantity of sulphuric acid. It is better to transform the sulphate into sulphide by calcining it with sulphur in a current of hydrogen. All the oxides of manganese can be likewise transformed into sulphides; for instance, manganite in large crystals completely changes into a compact green sulphide, yet preserving entirely its original form.

Iron.—Precipitated sulphide of iron is operated upon in exactly the same manner as oxides of iron. Care must be taken to make it red-hot, in order to expel an excess of sulphur which is strongly retained by the sulphide FeS.

Zinc.—Zinc is easily estimated by the same method, whether in the state of precipitated sulphide, sulphate, carbonate, or oxide. Only it should be remarked that some loss is to be feared in calcining oxide of zinc in a hydrogen current without having previously added a sufficient quantity of sulphur. A part of the oxide would, in fact, be reduced and the metallic zinc volatilised.

Cobalt.—When the sulphide of this metal is treated as above it yields sulphides, the composition of which alters according to the temperature to which the crucible is subjected, varying from CoS_2 to CoS, and even at a red-white heat as much as Co_2S. It must, therefore, be estimated by the old method, by dissolving the sulphide in aqua regia, and precipitating the oxide by potash,—a process liable to error, as the potash can never be entirely removed by washing unless the oxide is reduced by hydrogen.

Nickel.—Sulphide of nickel, precipitated by hydrosulphide of ammonium and anhydrous sulphate of nickel, can be transformed by calcination at red heat in contact with sulphur in a current of hydrogen into a sulphide the composition of which is not so constant as that of the sulphides of manganese, iron, and zinc. It is generally produced as a thick, pale-yellow mass, with metallic lustre, compact fracture, in composition answering to the formula Ni_2S, which Arfvedson has already obtained by passing a current of hydrogen at a red heat over sulphate of nickel. This sulphide does not answer for estimating nickel, and, therefore, the ordinary method must be employed.

Cadmium.—The sulphide of cadmium cannot be calcined without loss, on account of its too great volatility.

Lead.—Sulphide of lead, precipitated by sulphuretted hydrogen, absorbs atmospheric oxygen when dried to 100°, and in proportion as the desiccation is prolonged. This inconvenience is not avoided even by washing the sulphide in alcohol after washing it in water. On the other hand, it is to be feared that the sulphide may contain an excess of sulphur. In either case error can be obviated by heating the sulphide to a red heat in contact with sulphur, and in a current of hydrogen. If the heat is insufficient, the sulphide PbS will contain excess of sulphur. It should be always perfectly crystalline.

Bismuth.—Sulphide of bismuth, precipitated by sulphuretted hydrogen, is among the small number of sulphides prepared by the humid method which is neither changed nor oxidised by desiccation; but it

appears to contain a little water, which is expelled only at a temperature verging on 200°. Precipitation being generally effected in an acid liquor and the sulphide of bismuth being attacked by nitric acid at the ordinary temperature, it often happens that the sulphide contains too much sulphur and too little bismuth. This circumstance renders it necessary to estimate the bismuth contained in the sulphide.

The reduction of sulphide of bismuth by hydrogen is too slow to deserve recommendation; therefore, the sulphide should be dissolved in nitric acid, and the bismuth contained in the solution estimated by the ordinary process. The sulphide may be also melted with cyanide of potassium; if the fusion has been long enough continued, all the bismuth is obtained in a metallic state. On the other hand, a certain quantity of black powder, consisting of a mixture of bismuth and the sulphide of this metal is obtained, which must be again fused with cyanide of potassium.

Copper.—It has already been shown that the foregoing method is particularly applicable to copper. It is immaterial whether this metal is in the state of sulphide oxide, or salt.

Silver.—Precipitated sulphide of silver can be easily dried and weighed on the filter. In certain cases it is advantageous to reduce the sulphide of silver at a red heat by a current of hydrogen, and to weigh the silver in the metallic state.

Mercury.—The sulphide precipitated from solutions of bichloride and binoxide of mercury, can be dried in the air at 100° and weighed on the filter. If the purity of the sulphide of mercury is questionable, it may be re-dissolved and operated on as follows:—To the washed precipitate add a weak solution of caustic potash, and pass a current of chlorine through the liquid. The sulphide is soon dissolved, especially if gently warmed; under these conditions, powdered cinnabar also dissolves. The mercury is entirely precipitated by sulphide of ammonium in a neutral or ammoniacal solution, without an excess of the re-agent dissolving the precipitate which forms. But this is not the case when the liquid contains potash or free soda, or the carbonates of these bases; here the alkali must be supersaturated with hydrochloric acid before precipitating the mercury.

Uranium.—The protoxide of uranium is not altered by calcination with sulphur in a current of hydrogen. As to the sesquioxide, it is changed into protoxide.—*Poggendorff's Annalen der Physik und Chemie*, t. cx., p. 120.

Vapour Densities at Low Temperatures.

A PAPER has been communicated to the Royal Society of Edinburgh by Professor Lyon Playfair, F.R.S., and Mr. Wanklyn, F.R.S.E., on A Mode of Taking the Densities of Vapours at Temperatures considerably Below the Boiling-points of Volatile Liquids. The authors pass a permanent gas, such as hydrogen, through the liquid which is to be vaporised at a certain temperature, taking the density of the mixed gases, and afterwards correct for the amount of hydrogen in the apparatus. The authors state that this method gives very accurate results. With a small quantity of the vapour of water, not exceeding 8 milligrammes in weight, they obtain the density of aqueous vapour within the usual errors of experiment.

They have estimated the vapours of various bodies, such as alcohol, acetic acid, &c., which, at temperatures even considerably above the boiling-points of the liquids, give abnormal densities, and they find them to be quite normal by this new method. The reason for this is, that a permanent gas prevents the tendency of the vapours to liquefy, and gives to it the character of a permanent gas, which expands equally for equal increments of heat, instead of the irregular expansion exhibited by those gases which are readily liquefied. Further details of this paper will be given when the Proceedings of the Royal Society are published.

On the Detection of Tartar in Vinegar,
by M. L. DUSART.

THE inquiry instituted by M. Dusart is founded on the solubility of potassio-tartrate of iron. The vinegar is evaporated to the consistence of extract, a little of which is dissolved in water, a few drops of solution of perchloride of iron are added, and the whole is boiled, and then sufficient solution of potash to give the liquid an alkaline reaction is poured in, then it is filtered.

If sulphuretted hydrogen indicates the presence of iron in the liquid, and produces no reaction in an alkaline liquor prepared with extract of vinegar without the addition of chloride of iron, we may infer the presence of tartaric acid, or at least the necessity for a stricter search, which is quite superfluous if the re-agent does not colour the liquid.

No similar results are obtainable from mineral, oxalic, malic, or citric acids. A counter-proof is always useful, because accidental substances, tartaric acid for instance, dissolve the sesquioxide of iron in an alkaline medium. —*Répertoire de Chimie.*

TECHNICAL CHEMISTRY.

On the Alloys of Copper and Zinc,
by FRANK H. STORER.

THIS research was undertaken in order to ascertain what, if any, definite chemical compounds could be detected among the alloys of copper and zinc.

Several chemists had already been led to believe in the existence of two or more definite alloys, and at the commencement of my own labours I was strongly inclined to accept this view. A more extended investigation, however, has convinced me that no such definite compounds exist. On the contrary, I am confident that all the alloys of copper and zinc are simply isomorphous mixtures of the two metals, capable, as I shall proceed to show, of crystallising at any point, from copper with only a trace of zinc, down to alloys containing but 30 per cent. of copper, or even less, under favourable circumstances.

The misconceptions of previous observers[1] have evidently arisen either from the great tendency to separate into layers, instead of immediately forming a

[1] I must in this connection refer to, and except, the valuable memoir of Karsten (vid. Karsten u. v. Dechen's *Archiv. für Mineralogie, u. s. w.* 1839, xii., 385), whose conclusions in regard to these alloys appear to be perfectly correct, with the exception of a few unimportant details. As is the case with the able research of the older Mallet, the details of which are to be found only in the Report of the Tenth (Glasgow) Meeting of the British Association for the Advancement of Science, p. 258, the very meagre abstracts of this memoir which are given in the chemical journals and text-books fail to convey a correct idea of the results which have been obtained,—a fact which may serve to explain the ignorance which has been exhibited in regard to them by subsequent experimenters.

homogeneous mixture, which the metals exhibit when fused together; or from certain striking peculiarities of structure and of superficial coloration which occur among the different alloys. To these points I shall again allude.

The method which I have used in preparing the alloys has varied slightly, according to the amount of copper contained in them. Those in which the proportion of copper was large were prepared by projecting granulated zinc by small portions into the molten copper, the crucible which contained it having been previously removed from the fire, the mixture being thoroughly stirred after each addition of zinc. This method succeeds very well when only a small amount of zinc is to be combined with the copper, perfect combination of the metals being readily obtained, while the loss of zinc from volatilisation, though considerable, is, if proper care be exercised, much less than would be at first sight supposed. But for alloys containing even as much as 50 or 55 per cent. of zinc, this method becomes uncertain.

It is in this case necessary to bring the copper to a high degree of heat before adding the zinc; yet in spite of this precaution, and of the utmost care in adding the zinc only by small portions, which have previously been made as hot as possible, the mass contained in the crucible will often become chilled, and require to be again placed in the furnace in order to be re-melted. Since the portion of zinc last added remains uncombined with the copper, and exposed at the surface of the mass, a great deal of it is lost during this operation.

In preparing alloys containing more than 50 per cent. of zinc, I have melted the copper and zinc in separate crucibles, and have subsequently poured the zinc upon the copper. It is necessary to remove from the fire the crucible which contains the latter, and to cover it carefully, with the exception of a small opening through which the zinc may be poured; for violent ebullition and projection of particles of the melted metal occur during the first moments of combination. After thorough stirring[2] in either case, the mass was allowed to cool until a crust had formed on the surface of the alloy. This crust was then pierced, and the fluid matter beneath it poured out. The cup thus formed, having been removed from the crucible, was sawn in two, and portions of the crystals upon its sides cut off by means of a cold chisel, for analysis. The sheets obtained from the fluid alloy poured off were also retained, and were subsequently analysed.

The weight of alloy obtained in each experiment varied from 2 lbs. to 6 lbs. By operating in the manner described, it is easy—especially after a little practice has enabled one to judge when the crust is ready to be pierced—to obtain perfect cups, lined with well-formed crystals.

The chief difficulty which presents itself depends upon the fact that the alloys containing more than 80 to 85 per cent. of copper solidify much more rapidly on top than upon the sides or at the bottom of the crucible. It is, therefore, necessary to allow a very thick crust to form before piercing, or no cup at all will have been formed, and the alloy will flow out entirely in the fluid state, with the exception of the upper crust.

Fine cups are formed by all the alloys between 80 and 45 per cent. of copper, the largest crystals being obtained when the crust is pierced while still quite thin; while the white alloys containing less than 40 per cent. of copper solidify, if anything, more rapidly on the sides and at the bottom of the crucible, rendering it necessary to pour out what alloy is still fluid almost as soon as a crust begins to form on top. All the white alloys are liable to pass suddenly into a pasty plastic state, similar to that assumed by zinc or by soft-solder while solidifying. On account of this peculiarity, it is exceedingly difficult to crystallise them. I have succeeded, however, in obtaining crystals of alloys as low down as 30 per cent. of copper, and have no doubt that, by repeated trials, they might be obtained from alloys still richer in zinc.

These crystals are all octahedral, usually somewhat elongated, and apparently much modified by the circumstances in which they have been formed. The edges of all of them are rounded. The octahedra are in general more largely developed upon one side than upon the other, apparently upon the side from which the last drippings of the melted metal fell. They are, moreover, combined together with parallel axes, which give to the crystals a striated appearance; these striæ are not sharply defined, but their edges have the rounded character of the edges of the crystals. This general character is maintained throughout the whole series of crystals, from those of pure copper down to those of the lowest white alloys which I have obtained. No doubt can possibly be entertained of the complete resemblance of these crystals to each other throughout the series, while the striking similarity to the well-known crystals of pure copper (obtained by fusion) which they exhibit, strongly indicates that they belong to the regular system. As it is of course impossible to measure the angles of such crystals, they cannot be crystallographically determined; but the most obvious conclusion is, that they are monometric. This opinion, however, must be based rather upon analogy than on any distinct measurements.

Upon the assumption that the crystals which I have described belong to the regular system, as well as upon the fact, which will appear in the sequel, that none of the crystals have been found to contain any larger quantity of either of their component metals than was contained in the remainder of the molten liquid from which they had separated, I have based my conclusion that the alloys of copper and zinc are isomorphous mixtures[3] of the two metals.

On this hypothesis it is of course presumed that both copper and zinc are capable of crystallising in the regular system. Copper, as is well known, always occurs in forms of the monometric system. But, in regard to zinc, this has not been so satisfactorily proved. Not only, however, does analogy indicate that zinc should be monometric,—for, so far as is known, all the metals of the three series of Cooke (Memoirs of American Academy [New Series], V. table to p. 256) allied to it crystallise in forms of this system,—but Nicklès (*Ann. Ch. et Phys.* [3], xxii. 37) has actually observed an instance in which it occurred in the form of pentagonal dodecahedrons.

I am well aware that this is an isolated example; that the angles of the crystals were not measured. It is not

[2] I have found that a rod of soapstone, eight or ten inches in length, cut somewhat tapering towards its point, screwed into a piece of ordinary one-inch iron gas-pipe, forms a very convenient stirrer. It should be ignited to expel moisture before being used.

[3] It must not be supposed that this view supports in the least the idea of the older chemists, that alloys were mere "mixtures" of their component metals. For the experiments of Karsten (*loc. cit.*, S. 398, 400) have already shown that the comportment of the alloys of copper and zinc towards acids, and the solutions of various metallic salts, is that of chemical compounds, being entirely unlike that of a simple mechanical mixture of the two metals, or of a mixture of several alloys.

to be supposed, however, that a chemist so well versed in crystallography as M. Nicklès could have been mistaken regarding the form of his specimen. We know, moreover, from the analyses of Favre (*Ann. Ch. et Phys.*, x, 170), that the zinc was almost absolutely pure. Gustav Rose (*J. pr. Chem.* [N. F,], lv. 292) has urged against this observation, that the form of the crystals is an improbable one, since no other instance is known of a metal crystallised in pentagonal dodecahedrons. I cannot myself perceive the force of this argument; few facts are more thoroughly established than that the crystalline form of bodies may be largely modified by the influence of the circumstances under which they are formed,—witness, for example, the crystals of common salt obtained from solutions containing organic matter (Vid. Robin et Verdeil, "Traité de Chimie Anatomique" [Paris, 1853], ii. 198, et Atlas, pl. 1),—while almost all the crystals of metals with which we are acquainted have been prepared by a single process—igneous fusion.

Rose has also maintained that the crystals of Nicklès are similar to the rounded or irregularly crystallised masses formed in an atmosphere of zinc vapour which he has himself obtained from the receiving-vessels of the Silesian zinc-furnaces, and which are, for that matter, familiar enough to those who have often had occasion to fuse zinc in covered crucibles. I would, however, suggest that the circumstances under which these *mammelons* are formed are by no means identical with those in which Nicklès's crystals were prepared (Vid. Jacquelain, *Ann. Ch. et Phys.* [3], vii. 204; and Favre, *loc. cit.*), viz., in an atmosphere of hydrogen, at a lower heat, and, doubtless, with less rapid volatilisation.[2]

(To be continued.)

On the Preparation of Pure Oxide of Lead, by M. Boettger.

This oxide, employed in the manufacture of matches, is now in great demand. In its preparation M. Boettger recommends that acetate of lead should be boiled with an excess of solution of chloride of lime, peroxide of lead, chloride of calcium, and acetate of lime are the result. The precipitate is washed until the chloride is removed.

The same oxide may be obtained also by passing chlorine through water holding minium in suspension; or, better still, by fluxing the minium with a combination of nitrate and chloride of potash. There is some danger of explosion in the latter process.—*Journal de Pharmacie et de Chimie*, t. xxxviii.

On a New Fusible Solder, by M. Wood.

For the preparation of an alloy suitable for soldering, that is to say, possessing at the same time great fusibility and the requisite tenacity and malleability, M. Wood melts together,

Cadmium	2 parts
Tin	4 „
Lead	2 „

The alloy thus obtained is very cohesive, perfectly malleable, and very tenacious; it melts at a temperature a little below 149° C., that is to say, from 28° to 30° below the fusion point of ordinary solder (lead and tin). It is superior to the latter, especially when used for soldering the alloys (as tinware) containing much tin, which are used in the arts, and generally in all cases where an easily fusible, tenacious, and malleable solder is required. With regard to these qualities, the inventor affirms that his alloy is in no respect inferior to the ordinary solders, while, on the other hand, it is much superior in these respects to the so-called bismuth solders, which melt at just as low a temperature. The new solder has been found of very superior quality, and very serviceable for casting and moulding.

Instead of directly preparing a special alloy, the proportion of cadmium above indicated may be added to the ordinary tinware solder (1 part lead, with from 2 to 3 parts tin). A higher degree of fusibility is thus obtained than when bismuth, which is sometimes added for the same purpose, is employed, and, unlike bismuth, cadmium does not lessen the tenacity and malleability of the alloy.

The proportions of the metals indicated in the formula can be modified in various ways without materially altering the product; if economy is desired, the proportion of cadmium can be reduced to $\frac{1}{10}$ and to $\frac{1}{15}$ of the amount of the other two metals without essentially diminishing the fusibility of the alloy for practical purposes. But the greatest fusibility is obtained by employing cadmium in the proportion of $\frac{1}{4}$ to $\frac{1}{8}$ of the united quantity of lead and tin.—*Journal of the Franklin Institute, Philadelphia*, t. xl., p. 125.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of Hydrogen-reduced Iron, and on the Means of Preserving it from Oxidation, by M. S. De Luca.

Pure iron in a state of minute division, known by the name of "iron reduced by hydrogen," so much used in medicine, is now largely manufactured, but without the least security as to its purity. Iron, prepared for industrial purposes, is almost always impure, for the simple reason that in its wholesale manufacture the purification of the re-agents and of the products is only partial;

[2] I have endeavoured to defend Nicklès's observation, the more especially because it is certainly as well entitled to be received by chemists as the experiments of Noeggerath (*Pogg. Ann.* xxxix. 323) and Rose, which go to prove that zinc may crystallise in forms of the hexagonal system. Neither of these observers has analysed the crystals which he has described, all of which were accidental products of smelting-works. Now we know from the researches of Cooke (Chemical News, Vol. I., pp. 289, 302; Vol. II., p. 49), that zinc, which contains only three or four per cent., and probably even a smaller quantity, of antimony, has a strong tendency to crystallise in the form of rhombic prisms of the compound $Sb\,Zn_3$ with excess of zinc. We have also the statements of Laurent and Holms (*Ann. Ch. et Phys.* 1835, [2] lx. 333), that zinc containing three or four per cent. of iron crystallises in rhombic prisms; and of Warren de la Rue (*Phil. Mag. J.* [3] xxvii. 370; also, *J. pr. Chem.* [N. F.] xxxvii. 126), who has obtained and measured rhombic prisms of composition,—

Zinc	90·00
Iron	2·56
Lead	6·00
Copper	1·44
	100·00

A. Erdmann (Berzelius, Traité, ii. 620) also has analysed acicular crystals of zinc which were detached from a bit of distilled zinc which had been used to decompose a quantity of chloride of silver. These needles contained,—

Zinc	93·193
Iron	6·324
Lead	0·283
	100·000

In view of all these data, showing the very great influence which the presence of a small amount of impurity may exert upon the crystalline form of zinc, the importance of the fact that we have no evidence whatsoever of the purity of the crystals described by Noeggerath and Rose is manifest.

there is a limit at which we must stop, but at which we do not find that degree of purity which should always characterise substances introduced into the animal economy. Moreover, the reduced iron of commerce is often mixed with fine iron filings, and sometimes it even consists entirely of ordinary iron reduced to very fine powder by a filing machine.

It is, however, easy to detect these sophistications. It is sufficient to treat the suspected iron by a pure diluted acid, which, if the iron is pure and contains no ordinary iron, will dissolve it, and produce a limpid solution free from residue. This process also affords indications of the sulphur contained in almost all reduced irons more or less abundantly; it can be detected by paper saturated with a solution of acetate of lead, placed in contact with the hydrogen which is evolved when iron is treated by a dilute acid, the paper becoming black if sulphur is contained in the iron.

It is very important to obtain iron exempt from sulphur, but it is impossible to get it pure by the ordinary industrial process; it must, in fact, be prepared in the laboratory with scrupulous care. To procure pure iron, an oxide of iron of almost absolute purity must be first prepared; but if this oxide is obtained by decomposing the sulphate of iron, it is almost impossible to get rid of a portion of adherent sulphate, which repeated washings fail to remove. It is preferable to decompose an acid chloride of iron by ammonia, in order to obtain the oxide pure. Hydrochloric acid eliminates all the sulphur from the iron, under the form of sulphuretted hydrogen, and boiling the acid solution is a sure means of driving off all trace of this gas which may lurk in the solution. Then, by precipitating the chloride of iron by ammonia, soluble and volatile compounds are formed, easily eliminated by heat and washing.

When we propose to obtain iron free from sulphur, it is not sufficient to provide pure oxide of iron; the hydrogen itself which is employed in excess in the operation of reduction must contain no sulphur. Those accustomed to the practical operation of a laboratory, and familiar with chemical manipulation, can appreciate perfectly all the difficulties to be encountered in purifying gas. The affinities between gaseous substances and re-agents are very limited, particularly when the latter are liquids; prolonged shaking is frequently requisite to obtain complete absorption; and it is scarcely necessary to recall here the fact that 3000 shakings are sometimes necessary to force sulphuric acid to absorb olefiant gas. Then, to purify hydrogen, there must be a slow disengagement of gas, which must be distributed through porous bodies, saturated with the proper re-agents, and these bodies must be introduced into tubes vertically disposed, and the gas enter at the superior extremity of these tubes. Thus hydrogen, notwithstanding its great lightness, traverses these tubes from above downwards, and comes in contact with the re-agents, depositing its impurities and losing all its sulphur.

The simple friction of the vulcanised india-rubber tubes generally used for connecting the different parts of apparatus, is another source of sulphur. A current of pure hydrogen or pure carbonic acid passed through these tubes will produce in the water through which the gases bubble up a deposit of sulphur, which can then be transformed into sulphuric acid by the action of nitric acid, and which can be weighed in the state of sulphate of baryta. Therefore, if india-rubber tubes are used, they should be boiled in a solution of potash before they are employed to join the different parts of a hydrogen apparatus, when this gas is employed to reduce the oxide of iron.

For the preservation of reduced iron from oxidation, it should be put into previously dried glass bottles; and this operation should be effected in an atmosphere of hydrogen. The iron should be introduced by means of glass measures, containing exactly a given weight of iron. The bulbs must then be sealed with the blowpipe. Thus it appears that all the reduced irons of commerce which have been examined contain sulphur; that they often deposit silica and blackish substances when treated by weak acids, and that consequently they are impure. It would be well if pharmaceutical chemists would themselves carefully prepare iron used for medicinal purposes, since manufacturers can only supply it of a relative purity.—*Journal de Pharmacie et de Chimie*, t. xxxviii. p. 275.

On Glycerine as a Medium for Collyria, by Dr. FOUCHER.

M. FOUCHER substitutes glycerine for distilled water in the various collyria he employs. Glycerine agrees perfectly with all the medicaments used for diseases of the eye, excepting nitrate of silver, which is decomposed when brought into contact with organic matter. The following is a list of the principal collyria recommended by M. Foucher:—

1.	Glycerine	30	grammes.
	Borax	2 to 4	„
2.	Glycerine	30	„
	Sulphate of zinc	1 to 3	„
3.	Glycerine	30	„
	Sulphate of copper	1 to 4	„
4.	Glycerine	30	„
	Tincture of iodine	4 to 8	„
5.	Glycerine	30	„
	Perchloride of iron	1 to 4	„
6.	Glycerine	30	„
	Tannin	2 to 4	„
7.	Glycerine	30	„
	Calomel	2 to 4	„
8.	Glycerine	30	„
	Laudanum	2 to 4	„

Only the purest and most perfectly neutral glycerine must be used for these preparations. Glycerine may be prescribed also with alum, neutral acetate of lead, sulphate of atropine, &c. &c.—*Journal de Pharmacie et de Chimie*, t. xxxviii.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY,

Thursday, November 15, 1860.

Professor BRODIE, *F.R.S., President, in the Chair.*

MESSRS. J. H. Player, A. Norman Tate, F. V. Paxton, H. Brunner, and G. W. Brown were elected Fellows.

Professor BOLLEY read a paper "*On the Crystalline Form of Metallic Chromium.*" Metallic chromium was prepared by the method of Wöhler. When magnified by a power of 85 diameters it exhibited an arborescent crystalline character, but the separate crystals were seen to be primary octahedrons, instead of rhombohedrons, as described by Wöhler. The octahedrons were referrible to the quadratic system. Hence, despite the isomorphism

of their salts, the metals, iron and chromium, are not isomorphous.

Professor Bolley also read a paper "*On the Colouring-matter of Persian Berries.*" Kane extracted from Persian berries, by means of ether, a substance which he termed chrysorhamnin. By boiling aqueous or alcoholic solutions of chrysorhamnin he obtained another compound which he called xanthorhamnin. Gellatly could not obtain any chrysorhamnin from Persian berries, but obtained xanthorhamnin by direct extraction with alcohol. He showed that xanthorhamnin was decomposed by boiling with dilute sulphuric acid into glucose and a body which he termed rhamnetin. Hlasiwetz published a paper on Quercitrin, in which he suggested that quercitrin was identical with xanthorhamnin, and quercetin with Kane's chrysorhamnin and Gellatly's rhamnetin,—a view supported by the results of the elementary analyses of the compounds. Bolley has made a recent examination of Persian berries, and his experiments support Hlasiwetz's views. Like Kane, he obtained chrysorhamnin direct from Persian berries by means of ether; but, unlike Kane, he could not from this chrysorhamnin obtain xanthorhamnin. He accounted for the discrepancy between Kane's and Gellatly's results by suggesting that Persian berries might sometimes contain the glucoside of chrysorhamnin, *i. e.*, quercitrin, or xanthorhamnin, and sometimes free chrysorhamnin, *i. e.*, quercetin or rhamnetin; but he was unable to explain Kane's production of xanthorhamnin from chrysorhamnin. Chrysorhamnin, or quercetin, gives a brick red precipitate with acetate of lead, and a blood-red liquid with nitrate of silver, which gradually deposits reduced silver.

Mr. F. Field read a paper "*On the Basic Carbonates of Copper.*" (This was given in the Chemical News, No. 51, p. 279.)

Dr. Hofmann, F.R.S., made a verbal communication "*On a Process for the Separation of the Ethyl Bases.*" The method of preparing these compounds by the action of ammonia upon iodide of ethyl instead of proceeding by four distinct phases and producing in four successive operations the iodides of ethylammonium, of diethylammonium, of triethylammonium and of tetrethylammonium in the pure state, thus :[1]—

$$H_3N + C_2H_5I = [(C_2H_5)\ H_3N]\ I.$$
$$(C_2H_5)\ H_3N + C_2H_5I = [(C_2H_5)_2\ H_2N]\ I.$$
$$(C_2H_5)_2\ HN + C_3H_5I = [(C_2H_5)_3\ HN]\ I.$$
$$(C_2H_5)_3\ N + C_2H_5I = [(C_2H_5)_4\ N]\ I.$$

in reality gives rise to the simultaneous formation of all the four compounds :—

$$H_3N + C_2H_5I = [(C_2H_5)\ H_3N]\ I.$$
$$2\,H_3N + 2\,C_2H_5I = [(C_2H_5)_2\ H_2N]\ I + [H_4N]\ I.$$
$$3\,H_3N + 3\,C_2H_5I = [(C_2H_5)_3\ HN]\ I + 2\,[H_4N]\ I.$$
$$4\,H_3N + 4\,C_2H_5I = [(C_2H_5)_4\ N]\ I + 3\,[H_4N]\ I.$$

The mixture of these iodides, when distilled with potassa, furnishes a product consisting of the three bases, ethylamine, diethylamine, and triethylamine, the hydrate of tetrethylammonium being decomposed by the heat into triethylamine, ethylene, and water. Dr. Hofmann stated that he had found it impossible to separate these three ammonias by distillation, the products, even after ten fractional rectifications, not being pure, although the differences between the boiling points of the three bases are considerable.

Ethylamine . . .	boils at 18° C.
Diethylamine . . .	,, 57°·5
Triethylamine . . .	,, 91°

On submitting the mixture of the three bases to the action of anhydrous oxalate of ethyl, the ethylamine is converted into diethyloxamide, a crystalline substance, soluble with difficulty in water; the diethylamine into diethyloxamate of ethyl; the triethylamine not being acted upon.

$$\left.\begin{matrix}(C_2O_2)''\\(C_2H_5)_2\end{matrix}\right\}O_2 + 2\left[\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}N = \left.\begin{matrix}(C_2O_2)''\\(C_2H_5)_2\\H_2\end{matrix}\right\}N_2 + 2\left[\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$$

Oxalate of Ethyl. Ethylamine. Diethyloxamide. Alcohol.

$$\left.\begin{matrix}(C_2O_2)''\\(C_2H_5)_2\end{matrix}\right\}O_2 + \left.\begin{matrix}C_2H_5\\C_2H_5\\H\end{matrix}\right\}N = \left[\begin{matrix}(C_2O_2)''(C_2H_5)_2N\\C_2H_5\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$$

Oxalate of Ethyl. Diethylamine. Diethyloxamate of Ethyl. Alcohol.

On distilling the product in the water-bath, *triethylamine*, free from diethylamine and ethylamine passes over. The residue in the retort consists of a solid crystalline mass, mixed with an oily body. The solid is drained from the oil, and purified by re-crystallisation from boiling water. This compound, which is diethyloxamide, on distillation with potassa, furnishes *ethylamine* free from diethylamine and triethylamine; the oily substance, when purified by distillation, yields pure diethyloxamate of ethyl,[2] which, when decomposed by distillation with potassa, furnishes *diethylamine* free from ethylamine and triethylamine.

Dr. Hofmann made some experiments illustrative of the process which he had described, and exhibited specimens of the pure ethyl bases, which had been prepared by this process, and some of their derivatives, which had been prepared by Mr. Groves, in his Laboratory.

SOUTH KENSINGTON MUSEUM.

On Food, by Edwin Lankester, *M.D., F.R.S.*

Lecture III. *On Starch and Sugar.*

I have to-day to call your attention to another group of Foods. We have spoken first of water, and then of the saline or mineral substances in food, and now we come to two groups of substances, the first called Combustible, from the fact of their being burned in the system; or, Carbonaceous, from the fact of their containing large quantities of carbon. The next group are called Nitrogenous, because they contain nitrogen.

Now, in this lecture, I shall draw attention to those heat-giving bodies, and may state, in the first place, that the heat which we have in the body is precisely the same as the heat which exists independently of the body, having the same nature and the same properties, measured by the same instruments, and producing exactly the same results; therefore, although we call the heat of the body animal heat, it is not at all different from the ordinary heat from a fireplace or lamp. Now, the ordinary heat that we find given out by a fire, or candle, or lamp, is the result of the union of carbon and hydrogen with the oxygen of the atmosphere. This spirit-lamp will illustrate it as well as anything. I have here a quantity of alcohol, composed chiefly of carbon and hydrogen, and we have two things coming off, the result of the union of carbon and hydrogen with the oxygen of the atmosphere. If I take this cold glass, and put it over the lamp, I collect immediately a vapour, which is the vapour of water. If I take a bottle, and put it over, you will find that I shall withdraw the source of the oxygen, and so the lamp will go out. I have here, in the bottle, the result of the burning of that lamp. There is a little water produced; but I have also carbonic acid gas from the union of the carbon with the oxygen. I have here some lime-water, and the lime-water, when it comes in contact with carbonic acid gas, produces a milkiness which is carbonate of lime, showing that I had carbonic acid gas there. Thus, then, we find, that ordinary combustion, attended by heat, is the result of the union of carbon and hydrogen with

[1] H = 1, C = 12, O = 16.

[2] Boiling at 260°.

oxygen gas, and that the substances formed during this combination are carbonic acid gas and water. Wherever heat is produced upon the surface of the earth, we find that it is the result of precisely the same process—the union of oxygen with carbon or with hydrogen.

Now, there are some cases in which animal and vegetable matters are exposed to the action of the oxygen of the atmosphere, and the result of the union of the oxygen with the carbon of the animal and vegetable matters is just the same as in the case of the lamp; but in these cases there is no light given out until it attains a temperature of 700° or 800°. When oxygen unites with carbon and hydrogen at lower temperature than 700°, no light is given out, but heat is generated. Thus, if you take a quantity of decaying vegetable matter in your garden, you get heat developed, which the gardener uses for his cucumber-frames; and it is an extraordinary fact, that the instincts of some animals have guided them to a way to avail themselves of this heat. There is the bush turkey of Australia, which does not make an ordinary comfortable nest, but heaps together the leaves of the forest in a great mass, then deposits her eggs and covers them up with leaves. The leaves give out a certain quantity of heat, which is sufficient to hatch the eggs, and when the young ones are hatched they come out of the heap and walk about. That is just one of the instincts of animals, in availing themselves of the decomposition of vegetable matter in the production of heat. Then occasionally we find vegetable and animal matter catching fire, especially the former. When cotton is heaped together it frequently catches fire of itself. This spontaneous combustion is a frequent cause of fire. This oxidation also goes on in living plants. A variety of experiments prove that at certain seasons the plant has a temperature higher than that of the atmosphere. This is especially the case with the plant which is commonly known as "lords and ladies:" the botanical name of which is *arum maculatum*.

This plant, if you put the bulb of the thermometer within its bud at the time of opening its flower, will show you that the temperature is much higher; during that time there is a true oxidation of the plant going on, and thus you have heat. Mr. Low, of Nottingham, has performed a very large number of experiments by a very delicate thermometer, and always found that the opening flowers had a higher temperature than the atmosphere. We also find this to be the case with animals; the body of the higher animals is constantly warmer than the surrounding atmosphere, and some of the higher animals, in fact, the majority of them, have a fixed temperature, which never changes. Thus it is that man has a fixed temperature under all circumstances. Whether living under the tropical sun of India, America, Africa, or at the Poles, his temperature is always 98° F. There is no departure from this, except in the case of disease. This is easily proved by placing the bulb of a thermometer under the tongue; of course the hand is exposed to the atmosphere, and you cannot get it from the hand, and so with the face; but the covered parts of the body always give 98° F. Now this temperature of 98° F., in the human body, must be maintained by resources quite independent of the external atmosphere; and these are supplied by the heat-giving food which we take. I have not time to enter fully into the question of how that temperature is maintained; but it is very curious to observe, that whilst we pass from regions where the temperature is 40° below the freezing point, to regions where the temperature rises to above the natural heat of man, that temperature of 98° F. is maintained in all cases. Now the cause of that is the structure of the skin. The skin is covered over the body in such a way, that the evaporation from its surface keeps the body always at the same temperature. If I had a hot vessel here, I could, by sprinkling water over it, keep the temperature at a fixed point, because the water, in passing from liquid to vapour, tak s up and absorbs a large quantity of heat, and carries it off. So that when we are exposed to warm climates and warm temperatures when the body does not require so large a quantity of heat-giving food as it has supplied to it, then the skin throws off the fluid which we call perspiration, and thus the temperature is kept down. It is the skin, then, that regulates the temperature of the body. I now wish to call your attention to these parts of the body by which the heating effect is produced. Our food is first taken into the stomach and digested; it is then taken up out of the stomach, and carried by the agency of little vessels, called absorbent vessels, into the blood, and brought into the venous system.

It then passes on to the right side of the heart into the blood-vessels at the side of the body, and thence along the veins into the lungs which lie on each side of the chest. Now, these lungs are so constructed that the blood may be thrown upon the largest possible surface of cells; and, while the blood is in those cells, it is exposed to the action of the atmosphere. Every time we breathe we take in a quantity of air from the atmosphere containing 21 parts of oxygen gas and 79 of nitrogen, and this atmospheric air passes down a tube which is called the trachea, and passes on to the lungs and then to the minute terminus cells; the oxygen gas of the atmosphere now meets the blood which has come from the right side of the heart, and there is a wonderful arrangement made by which the oxygen of the air actually penetrates through the vessels, so that the little blood-globules receive the oxygen from the outside without any direct exposure to the air, there being a membrane lying between the blood and the atmosphere, and it is through that membrane that the air penetrates. It is one of the wonderful physical properties of this membrane that it has the power, when moist, of absorbing the air. The blood has been brought up from the heart, of an almost black colour, but no sooner has it penetrated the lungs and been exposed to the oxygen than it becomes bright red. Then it passes back, by means of the veins, to the left side of the heart. It goes out of this vessel and back to the left auricle, which contracts and sends the blood into the left ventricle, and this contraction sends it into the great aorta which, in the end, distributes the blood into all parts of the system,—beating, beating with every pulse of the heart. It now contains the oxygen gas, and, when the blood has got to the extremities of these large arteries, it goes into a minute kind of vessels which we call capillary vessels, and it is in these vessels that the union of the oxygen and carbon takes place by which the animal heat is produced which we feel all over the body. In every part of the body are these minute vessels distributed, and, whilst we are living, whilst we are thinking, whilst we are acting, whilst we are performing the various functions of life, we are doing so under the agency of this life-giving oxygen. The oxygen and carbon are united, and, just as that lamp has no light without it burns, so have we no life without we burn. Every portion of our body must be thus heated and in a state of combustion, or we die. You saw how that lamp went out when I put something over it. So it would be with any one of us. If I were to put you under that jar for three minutes, you would die as certainly as if you were to be drowned; so, if we hang a man up by a rope round his neck for five minutes, we thus cut off the supply of oxygen,—it destroys his life,—and that is the way that we judicially dispose of our great criminals.

The oxygen has now united with carbon, and heated the whole body, and produced carbonic acid gas, and now that these little vessels have lost their oxygen this carbonic acid comes back to the blood, and the blood now goes through these little cavities, coursing its way, until it comes to the right side of the heart once more. It then goes to the lungs, charged with carbonic acid gas. It delivers up the carbonic acid gas at the moment when

it takes in the oxygen; and this carbonic acid gas goes out of our lungs every time we respire. It is not a very difficult experiment to show this. Here is a vessel which I have filled with air from my lungs instead of with water; and, just as I filled it just now from that lamp when the lamp went out, so have I filled this jar with carbonic acid gas from my lungs; and now in the same way I shall form carbonate of lime by adding lime-water to it. There you see, it is quite milky, just as it was before.

I am not anxious to dwell on the properties of carbonic acid gas, but you see it is a product of combustion. We found that it would not support the life of the lamp. When I covered the lamp it went out, because there was no more free oxygen. Just as the lamp goes out in an atmosphere of carbonic acid gas, just so we go out; and just as this lamp will burn slowly in an atmosphere charged with carbonic acid gas, so do we burn sluggishly in an atmosphere charged with carbonic acid gas. This proves the necessity of getting rid of the carbonic acid gas entirely from our houses, from our sitting-rooms, and from our places of assembly; but above all things, of getting rid of it from our sitting-rooms and sleeping-rooms, where we spend the larger portion of our lives. I believe there is evidence to show that the want of pure air, and the retention of carbonic acid gas, are the great sources of one of our most terrible and afflicting diseases —Consumption. The want of a due supply of fresh air, and the want of getting rid of this carbonic acid gas from the house and the lungs, are the greatest sources of this disease. That is a point of great practical importance, to which I call your attention incidentally, for there is no one here who is not interested in that great question. Care should therefore always be taken, and the proper means secured, for letting fresh air into rooms, and carrying off the heated and poisonous carbonic acid gas.

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, December 3, 1860.

Sir Charles Hamilton, *Bart., C.B., in the Chair.*

The Rev. Alexander Denny, M.A., and Henry Snaith, Esq., were elected members of the Royal Institution, and Carl Haag, Esq., was admitted a member of the Royal Institution.

Henry Bence Jones, M.D., F.R.S., was elected Secretary of the Royal Institution, in the room of the Rev. John Barlow, M.A., F.R.S., resigned, who was elected a manager.

The following arrangements for the Lectures before Easter, 1861, were announced:—

Six Lectures on the Chemical History of a Candle (adapted to a juvenile auditory), by Michael Faraday, Esq., D.C.L., F.R.S., &c., Fullerian Professor of Chemistry, R.I.

Twelve Lectures on Fishes, by Richard Owen, Esq., D.C.L., F.R.S., Fullerian Professor of Natural Physiology, R.I.

Twelve Lectures on Electricity, by John Tyndall, Esq., F.R.S., Professor of Natural Philosophy, R.I.

Ten Lectures on Inorganic Chemistry, by Dr. Edward Frankland, Esq., F.R.S., Lecturer on Chemistry at St. Bartholomew's Hospital.

Composition of Marrow.—According to Dr. Carl Rylerts (*Wittstein's Vierteljahresschrift*, Bd. ix. s. 330) the marrow of oxen consists of compounds of glycerine with elaic, palmitic, and a new acid which the author names *medullic*. Medullic acid has the formula $C_{42} H_{42} O_4$, and its melting point is 72·5°. The proportions in which the acids are found in the marrow are as follows:—Palmitic acid, 46 per cent.; medullic acid, 10 per cent.; elaic acid, 44 per cent.

CORRESPONDENCE.

On the Alloys of Iron and Nickel.

To the Editor of the Chemical News.

Sir,—The very interesting experiments of Mr. W. Fairbairn on the Alloys of Nickel and Iron, noticed in No. 52 of your periodical, appear steps in the right direction towards ascertaining the cause of the extraordinary tenacity and ductility of meteoric iron, and, it is to be hoped, of an improvement in manufactured iron.

The iron used by Mr. Fairbairn in his experiments is stated to have been Welsh cast-iron, containing (it is to be presumed in the absence of any analysis) the ordinary quantity of combined carbon (about 3 per cent.). Now meteoric iron, the substance sought to be imitated, does not contain any notable quantity of that element (carbon), the addition of which to iron is so well known to impart brittleness. On referring to the analysis of thirteen varieties of meteoric iron by Berzelius, Rammelsberg, Jackson, Hayes, and others, scarcely a trace of carbon is to be found combined with the irons they examined, and even the traces of that substance may be accounted for, by the fact that many meteorites contain graphite dispersed through their substance. I have now two specimens of iron in my cabinet, one of which is native iron of terrestrial origin, and the other a portion of the Tolucca meteorite, in which layers of graphite are plainly discernible. Rammelsberg states that he found in the Seeläsgen meteorite 6·62 of uncombined graphite. The absence of carbon, therefore, in meteorites, in an uncombined state, tends strongly to show that the iron, of which they consist, more nearly approaches in composition to artificial malleable iron than to cast iron. This supposition is also further borne out by the peculiar structural character of meteoritic iron, so clearly displayed when a polished surface of it is subjected to the action of dilute nitric acid, by which the fibrous and partially laminated structure is brought out, differing so widely from the crystalline texture of cast-iron.

Mr. Fairbairn appears not to have attempted any experiments with his ingots in a forged state, but only as cast. Had he done so, it is not improbable that features might have been brought forth which would have led to a nearer approach to the desired end. There is a fact connected with meteoric iron proving that the action of heat will materially alter its structure, as the mass found at Bithberg, in Prussia, became after it had been partially fused, extremely crystalline and brittle. I have examined a portion of it in this state, and can affirm that it is more brittle than ordinary cast-iron, whilst a portion of the same iron, in its original state, possesses all the tenacity of meteoric iron in its usual form.

In meteorites that have been treated as I have mentioned with dilute nitric acid, there are broad spaces and lines that appear not to have been acted upon at all by the acid, and these portions are stated to contain a higher per-centage of nickel, and also some phosphorus. Dr. Hugo Muller in his account of the Zacatecas meteorite, which he analysed, says that the composition of that portion insoluble in nitric acid was

Iron	75·02
Nickel	14·52
Phosphorus . . .	10·23
	99·77

From this it would appear that nickel exercises an influence over iron similar to platinum, and protects the iron from oxidising influences. In most of the analysed meteorites the proportion of nickel would appear to vary from 3 to 24 per cent., according to the portions selected. If, in native iron, so large a quantity of nickel can exist

without impairing its tenacity, surely artificial alloys can bear as wide a range if the iron used is pure.

As Mr. Fairbairn intimates his intention to conduct a series of experiments on alloys of malleable iron and nickel, it is to be hoped that he will not overlook the fact of the almost total absence of carbon in the substance he is trying to imitate, to which it is not improbable that his ill success with the Welsh cast-iron alloys may in some degree be attributable.—I am, &c.

W. H. T. Allen.

7, Symonds Inn, W.C.

The Residue from the Combustion of Gunpowder.

To the Editor of the Chemical News.

Sir,—I can confirm the statement of M. de Saint-Robert, referred to in No. 51 of the Chemical News, "That the Residue from the Decomposition of the Gunpowder used in practice, is sulphide of potassium and not sulphate and carbonate of potash, as asserted by Bunsen and Chiskoff."

A short time ago, I witnessed some mortar practice, and noticed that after six or seven shells had been thrown, the chamber of the mortar was, more or less, covered with a red deposit. The latter could be easily scraped off, was found to be very deliquescent, emitted much sulphuretted hydrogen on being acted upon by an acid, cauterised the skin, and, indeed, possessed all the physical and chemical characters of the substance that is described in books as monosulphide of potassium.

An eminent military authority, who was present, and who well knew the difference between sulphide of potassium and sulphate of potash, told me, that at various times and in various places, he had used many different kinds of gunpowder, but that after firing there always remained the same soft, red, badly-smelling deposit.—I am, &c.

J. Attfield.

The Specimen Exchange Club.

To the Editor of the Chemical News.

Sir,—It is with much regret that I notice with what indifference the proposed "Specimen Exchange Club" is regarded, and I wonder that scientific men have not seen at a glance the benefits and advantages which would result from the formation of this Club. In the last letter I wrote to you on this subject, I proposed an addition to the rules, and my letter, and the rule I proposed, appeared in a late number of your periodical. I should like to know if any one agrees with me in adding this rule; and if there really is any one who wishes for the establishment of this Club?—I am, &c.

J. C. S.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Phosphorus in the Atmosphere.—M. Barral has made the important discovery that rain water contains a notable quantity of phosphoric acid. He evaporated to dryness in a platinum vessel 1295 litres of rain-water, collected in Paris, and 390 litres collected at Brunoy. The first yielded 22·6 milligrammes of dry residue per litre, and the second 7·8 milligrammes. The phosphoric acid obtained varied from 0·05 milligrammes to 0·09 milligrammes per litre. From these results, M. Barral calculates that rain-water may bring annually about 400 grammes of phosphoric acid to the hectare of soil. The author supposes that the phosphorus exists in the atmosphere in the form of phosphate of lime carried by the wind as dust; and also, perhaps, as phosphuretted hydrogen, the product of the putrefaction of animal matters. Another source may be the minute organised beings which MM. Bineau and Pasteur have shown to exist in the atmosphere.—*Cosmos*, t. xvii. p. 601.

II. ORGANIC CHEMISTRY.

Chemical Researches on the Latex and Cambium.—The *latex*, or elaborated sap contained in the lactiferous vessels of plants, it is difficult to obtain quite pure. M. Fremy has, however, by making careful incisions, obtained from various plants a fluid of almost constant composition which he has called *albuminous latex*. This fluid possesses some remarkable properties. When heated it becomes a white mass, like white of egg and the serum of blood. A trace of nitric acid or tannin does not simply coagulate it, but solidifies it. Ordinarily it is alkaline, like albumen and serum. When evaporated it leaves 13 per cent. of residue which is almost entirely albumen. The ashes consist mainly of alkaline chlorides and carbonates. If kept in the air for some time the latex coagulates and forms a sort of membrane (unorganised, of course), which seems to be due to the action of an astringent principle present in the tissues adjoining the lactiferous vessels. This substance has the power of gelatinizing the albuminous fluid, and so, as M. Fremy suggests, forming the *cambium*. The elaborated and descending sap the author supposes to be a mixture of many different liquids, some carrying vegetable excretions, and some, like the latex, serving as the material for organisation. We may add that the author's experiments succeeded best with the liquid drawn from the parenchyma of the pumpkin.—*Comptes-Rendus*, t. li.

Saponification of Fats by Anhydrous Carbonates.—M. Scheurer Kestner (*Annales de Chimie et de Physique*, t. lx. p. 216) shows that, when fats are heated with anhydrous carbonates to about 260° C., the carbonic acid is disengaged, and the acids of the fats combine with the oxide to form true soaps. For instance, if 100 parts of tallow are heated with from 22 to 25 of carbonate of soda to 260°, an energetic action commences, the mixture swells up, and an abundance of gas is evolved. The operation must be conducted in a capacious retort to avoid loss, and the heat must be moderated as soon as the action is set up. Towards the end, however, the heat must be increased, in order to ensure the decomposition of the last traces of the fatty matter. After some hours, a yellowish, semi-fluid mass is obtained, which becomes more or less solid on cooling. When treated with water this mass slowly dissolves, yielding an opaline solution, which behaves exactly like that of ordinary soap. If carbonate of lime be employed in the proportion of 18 or 20 parts to 100 of tallow, the reaction takes place more easily than with the soda salt. With carbonate of lead the action is more violent. The same takes place in all cases where vegetable oils are used instead of tallow. In the course of these re-actions, when the heat is carefully regulated, no glycerine is produced, but the oxide of glycerine is decomposed, furnishing marsh gas, free hydrogen, and a little acroleine, while the fat acids remain unacted on.

Composition and Properties of Chlorophyll.—Pfaundler (*Annalen der Chimie und der Pharmacie*, bd. cxv. s. 37,) pounded up a quantity of grass, expressed the liquor, and boiled it. The coagulated portion he collected on linen, and then extracted with alcohol. On distilling off the alcohol a soft dark-green jelly was obtained. When this was heated with water it formed a pale yellow solution in which floated some dark-green flocculi. After boiling and stirring, the mixture was allowed to rest, on which the dark-green part sank to the bottom, so that the clear yellow liquid could be poured off. The raw chlorophyll was then dissolved in hydrochloric acid, and the solution filtered. The emerald-green solution so obtained was precipitated with hot water, and the green flocculi separated and washed until free from hydrochloric acid. Chlorophyll so purified the author

found to have the following properties:—When dry it appears as a dark-blue powder; alcohol and ether dissolve it, forming solutions which appear of a dark, almost blood-red, colour by reflected light, and of a yellowish-green by transmitted light. The solution in sulphide of carbon was brownish-yellow. Weak potash ley dissolves it, while from a concentrated potash solution it separates in resinous lumps. There was no appearance of reduction when treated with lime and sulphate of iron. Two analyses gave:—

I.	II.
C60·85	C60·82
H 6·35	H 6·41
O32·80	O32·77

Preparation of Manure.—M. Chodzko has contrived a method of obtaining a manure by evaporating the liquid parts of the contents of the *fosses d'aisances* of Paris. (*Annales de Chimie et de Physique*, t. lx. p. 201.) The method is not described, but is said to be the same as that employed in evaporating weak saline waters. The resulting manure was found by M. Louis L'Hote to be twice as rich in ammonia as the *Poudrette*, prepared by evaporating night-soil to dryness without separating the solid and liquid parts.

Quinine Green.—This new colour has been prepared by M. Kœchlin in the following manner. (It was formerly produced by MM. Brandes and Leber in treating sulphate of quinine by chlorine water and adding ammonia.) M. Kœchlin takes 10 grammes of sulphate of quinine dissolved in 1000 grammes of water, and adds 0·128 of a litre of hypochlorite of lime, then 0·032 litre of hydrochloric acid, and immediately afterwards 0·192 litre of ammonia. The whole is then gradually warmed, cooled, and the precipitate collected on a filter. Quinine green, thus prepared, resembles a green resin, melts when heated, and is decomposed at a higher temperature. It is insoluble in water, benzol, turpentine, sulphide of carbon and ether, but dissolves in alcohol, wood spirit, and glycerine. Acetic acid turns it blue, strong acids dissolve it with a brown colour, the green returning when the acid is neutralised, and alkalies precipitate it from its solutions. The alcoholic solution of this colour dyes silk green; it also dyes woollen and cotton when mordanted with albumen.

LABORATORY MEMORANDA.

Removal of Nitric Acid Stains from the Hands.—By M. Schwarz.—We know that nitric acid stains the skin yellow, and that it is impossible to remove the discolouration by ordinary re-agents. We know also that these stains disappear only when the epidermis is renewed. M. Schwarz advises for their removal the use of sulphide of ammonium, with the addition of a little caustic potash. By this means the colouring matter is not destroyed, but the burnt epidermis is converted into a soapy substance, which can be scratched off with a small piece of wood, the nail, or rubbed off with sand. By washing with a little dilute sulphuric acid, the skin becomes clean and recovers its natural whiteness. M. Schwarz believes that in some cases the above combination might be used as a caustic, and that its application might prove serviceable in certain affections of the skin.—*Rép. de Chimie.*

MISCELLANEOUS.

To Bleach Toilet Sponges.—The finest and softest sponges are chosen, and after having been washed several times in water are immersed in dilute hydrochloric acid to dissolve out the calcareous matters. They are then washed in water again, and afterwards placed in another bath of dilute hydrochloric acid to which six per cent. of hyposulphite of soda, dissolved in a little water, has been added. The sponge is left in this bath for twenty-four hours, or until it is bleached as white as snow, and is then washed several times in fresh water.

Government Science Examination at Huddersfield.—The results of the collective examination of Chemical Students held in the Northgate School, Huddersfield, on the 24th ult., have been received. The examiner, Capt. Donnelly, R.E., states that the general results of the examination are very good. The following is a list of the successful candidates:—First Grade, Queen's Prize—Dan. Dawson, Frederick Ashwell, R. Donkersley, Sidney Thornton. Second Grade. Queen's Prize: George Tindall. Third Grade, Queen's Prize: William S. Brook, Walter Smith Brook, Alfred Barrowclough, W. N. Haigh, and William Vickers. The following have likewise passed a creditable examination:—J. R. Sykes, J. J. Milnes, Richard Bower, B. O. Haigh, Frederick Eastwood, W. E. Robinson, Henry Challand, William Lee, H. P. Battersby, James Thornton, George Hampshire, and Thomas Dawson.

Adulteration of Food.—*Apropos* of adulteration, perhaps there is not so much deception practised with any other article of food as with butter. London milk is doubtful enough, and so are many other articles of daily consumption; but, after all, the admixture of calves' brains, chalk, water, and anatto, we have always believed that the *basis* of the milk vended in the metropolis comes from the cow, even though the animal be kept in a close stable in a back street, and fed upon grains; but we believe there are tons of butter sold in London, in the production of which cows have never taken the slightest part. Hundreds of barrels of the clarified fat of horses and other animals are sent from that savoury "isle" by King's-cross, called Belle, to Ostend; and the article is then imported into England as genuine butter. Perhaps it is well that we do not know exactly what we eat. Only fancy those tempting blanc-manges and jellies being made of the tendons and sinews of used-up horses! Many truths are unpalatable—this is especially so; but then it *is* truth.

Death in the Toy-shop.—If those women who have been accustomed to provide for their offspring by the summary and uncleanly use of a lethal weapon had only been aware of the ease with which they might have accomplished their purpose through kindness, they would have avoided the disagreeable risk of being suspended by the neck,—a contingency which, it must be confessed, is rather remote in the present day. It is not, however, in the interest of these members of society that we feel it our duty to point out the manner in which an act of kindness may be productive of deadly results, but as a warning to those who would wish to avoid seeing their offspring come to an untimely end. A few days since a sudden and heavy rain drove us for shelter into the Lowther Arcade, and while there we amused ouselves for a time by watching the children turn over the toys displayed, embarrassed in their choice of an object by the very extent of the choice offered. We could not help remarking the extreme brilliancy of the green paint with which some of them were decorated, and the idea at once occurred to us that arsenite of copper might count for something in this. We bought three or four toys embellished with this colour, and, on reaching our laboratory, subjected them to analysis, the result of which proved that arsenic, in the form of arsenite of copper, was there present in so large a proportion as to render it a most dangerous risk to place such playthings in the hands of children. We believe it to be a well-known fact that the brighter the colour the greater the tendency of infants to subject it to the test of taste; and as the paint in question was

at once removable on the application of water and a little gentle friction, there would have been no obstacle to the full gratification of this juvenile propensity. Having detected this poisonous colouring pigment, which bears the innocently-sounding name of "Scheele's green," in the paint which covered these toys, we may safely assume that its use is general; for there was no perceptible difference between these and those we saw at other shops. However, we intend to make some further researches to set this point at rest. The discovery we have made is of grave importance, and we would earnestly advise all who are responsible for taking proper care of the health of children to banish all painted toys from the nursery. It may not be easy to point to cases where such playthings have been known to cause death, but we cannot doubt that they have frequently been the cause of serious illness, and possibly may have been the unsuspected ruin of many constitutions.

Oil-Wells of Pennsylvania and Ohio.—A strong impulse has been given to the explorations for petroleum by the success of the well at Titusville, Pennsylvania, worked for some years past by the Pennsylvanian Rock Oil Company, on Oil Creek. In a circuit of five miles from Titusville, there were, early in July, over 400 wells in progress, and 100 at work, raising from 10 to 50 barrels daily from depths varying from 40 to 300 feet. The crude oil is dichromatic, having by transmitted light a dark brown colour, which by reflected light is greenish or bluish. Its density is 0·882. It is, even in warm weather, rather thick, and in cold weather is more stiff, but even at —15° is still fluid. Its odour is strong and peculiar from the Pennsylvania wells, but from the wells at Mecca, Ohio, it is nearly odourless. It boils at a very high temperature, but begins to distill a thin colourless oil, even at 212° F. By fractional distillation, I obtained from 304 grammes of crude oil of Titusville:—

	Temperature.	Quantity.	Density.
1st Product at	100°C. (acid water)	5 gms.	
2nd ,,	140°C. to 150°C.	26 ,,	·733
3rd ,,	150°C. to 160°C.	29 ,,	·752
4th ,,	160°C. to 170°C.	38 ,,	·766
5th ,,	170°C. to 180°C.	17 ,,	·776
6th ,,	180°C. to 200°C.	16 ,,	·800
7th ,,	200°C. to 220°C.	17 ,,	·848
8th ,,	220°C. to 270°C.	12 ,,	·854

The boiling points of these several fluids present some anomalies, but are usually progressive; thus,

No. 2 began boiling at 115°C. remained constant at 228°C.
3 ,, ,, 120°C. ,, ,, 270°C.
4 ,, ,, 140°C. ,, ,, 290°C.
5 ,, ,, 160°C. and still rising at 308°C.
6 ,, ,, 135°C. rose rapidly above the range of mercurial thermometer.
7 ,, ,, 135°C. and still rising at 305°C.

The first five products remained entirely fluid at the low temperature of — 15° F.—8.

Odling's Chemistry.—Dr. Odling, F.R.S., Secretary to the Chemical Society, and Professor of Practical Chemistry at Guy's Hospital, has prepared for the press a "Manual of Chemistry, Descriptive and Theoretical," which will shortly be published. This work is intended as an elementary text-book, for the use of those lecturers and students who employ, or wish to employ, the unitary system of chemistry, according to which the molecule of water is represented by the formula H_2O. Water thus becomes a unit of comparison, to which the majority of oxides, hydrates, acids, salts, alcohols, ethers, &c., can be referred. Moreover, the anomaly of the vapour-density of water is hereby obviated, and its volume-equivalent made to correspond with that of other compound bodies. This system has been made the basis of elementary teaching by Professor Brodie at the University of Oxford; by the author at Winchester College, Hants; and by its chief English exponent, Dr. Williamson, at University College, London. It is believed that other chemists, who have fully recognised the merits of the system, and materially aided its development by their researches, would have adopted it in their public teachings, had there existed any suitable manual to which they could have referred their pupils. Dr. Odling's work will be published in Two or Three Parts or Sections, of which the First is nearly ready, in crown 8vo.

TO OUR READERS.

In accordance with the wishes of several of our correspondents, the present Volume of the CHEMICAL NEWS will not terminate until the end of the year. Our Third Volume will commence with No. 57, to be published on January 5, 1861. Several important alterations and improvements are in contemplation, full particulars of which will, if possible, be announced in our next Number.

ANSWERS TO CORRESPONDENTS.

D. Clifton.—We know of no book specially treating of the Chemistry of Brewing. Abel and Bloxam's Handbook of Chemistry is about as good a work as you can have for general instruction in Chemistry; and until you are familiar with general chemical manipulation and analysis, you would not reap much benefit from a special work. There is no strict meaning in the term "organic matter." So many diverse substances come under that category that the weight of organic matter corresponding to 6 milligrammes of $KOMn_2O_7$ could not be definitely given.

W. Rickard.—There are several good works on Electro-plating. See Napier's Electro-metallurgy, which is the one we have used. The recipe given has succeeded in our hands.

A Country Subscriber.—Can you not let us have more particulars respecting your inks and paint? We might possibly then be able to help you.

G. F. Rodwell.—Your letter came too late to be attended to. In our opinion the suggested alterations would not have been improvements as regards scientific accuracy.

M. Carey Lea.—Our correspondent's letter has just arrived, and will appear in our next number.

W. M. S.—In our next.

A. D.—*Eau Sédative* is a French mixture, essentially a weak preparation of camphor. In England, camphor-water is usually given in its stead.

F. N. and Sons.—We have been unable to learn anything respecting the Anthracite you name, viz. "Magnesia before the last process is complete." The only Anthracite we have heard of is the coal of that name.

W. D.—We will try and obtain for you the desired information. Most of the questions are, however, of such a character that only a person of considerable practical experience in dye-works could satisfactorily answer.

A Constant Reader.—Compressed gas was formerly furnished by a Company to the public, but we believe the idea has long been abandoned. Mr. Darker, of Paradise Row, Lambeth, had (a few years ago) several of the wrought-iron vessels, and he would most likely be the best person to apply to, should you wish to obtain any

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TO OUR READERS.

WE have this week to announce a change which will not, we trust, be unacceptable to our readers. For some months past it has been a source of increasing anxiety to find space in the limited number of columns at our disposal for important Lectures, translated articles, and valuable contributions, which the growing popularity of the CHEMICAL NEWS is attracting towards it each week. The modest number of pages which we at first deemed adequate to meet the requirements of a weekly Chemical Newspaper, have even during the autumn recess proved scarcely numerous enough to chronicle the progress of Science; and now that the learned Societies have re-assembled, and the important Royal Institution Lectures, by FARADAY and others,—the reporting of which was so prominent a feature at the commencement of our career—are about to commence, an increase of size becomes imperatively necessary.

It has, therefore, after mature deliberation, been decided to increase our weekly number of pages to SIXTEEN, exclusive of Advertisements, and, at the same time, to raise the price of each number to Fourpence. The contemplated change will come into operation with No. 57, the first number of the new year, and the first also of our Third Volume. At the same time our Office will be removed to a more central locality,—Messrs. GRIFFIN, BOHN and Co. (late Richard Griffin and Co.), 10, Stationers' Hall Court, E.C., having undertaken the publishing and business management of the CHEMICAL NEWS. No alteration will take place in the Editorial management, but arrangements are in contemplation by which the staff of writers and contributors will be reinforced by several eminent Chemists and Men of Science, who have kindly undertaken to address the readers of the CHEMICAL NEWS on various subjects of interest in their respective branches of learning.

At present we can do no more than mention that such changes are proposed; further and fuller particulars will be given before the close of this volume. We will, therefore, merely add, that the increased responsibilities of our position shall in no wise diminish that which has from the commencement been our earnest endeavour,—namely, to render this paper, in fact as well as in name, the veritable organ of Scientific and Chemical News.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Juices of the "Ficus Elastica" and the "Isonandra Gutta" (India Rubber and Gutta Percha), by A. ADRIANI, *M.D., Math. Mag. Phil. Nat. Dr. F.R.N.I.E., &c. &c.*

(Continued from page 291.)

As might be expected, substances of so great usefulness to society and science were early submitted to elementary analysis. It is hardly necessary to mention that both caoutchouc and gutta percha in the pure state are compounds of carbon and hydrogen. One of the first analysis made of gutta percha was published by Soubeiran, who mentioned that he had received the sample analysed by him from the French Minister of Commerce, under Louis Philippe's reign, and that the gutta percha had been brought from China by a committee of gentlemen sent by the French Government to that country to try to open up commercial relations with the Chinese: it was hence considered a Chinese produce. I (Dr. Adriani) had an opportunity of making inquiries about this point from the personal acquaintance with China of Dr. Gützlaff, the famous missionary, who, just about the time I was engaged with my experiments on gutta percha, happened to be in Holland. Dr. Gützlaff told me that the Chinese used gutta percha before it was known to Europeans, but that no gutta percha is obtained in China, as the *Isonandra Gutta* does not grow at higher Northern latitudes than from 12° to 15°, while the most Southerly boundary of China is about 18° N. latitude. When at Montpellier, M. Jules Itier, Directeur-en-Chef des Douanes pour les Départments du Gard et de l'Hérault, and formerly a member of the committee which made the journey to China, told me that they had received the first sample of gutta percha from Chinese traders about Macao.

Returning to Soubeiran's analysis, I have first to observe that the figures given as found by him, in "Erdmann's Journal," vol. xxxix., p. 373, differ very essentially from the figures as given for identically the same analysis in *Dingler's Polyt. Journal*, bd. ciii. p. 415.

According to "Erdmann's Journal," Soubeiran obtained:—

C 83·5	H 11·3
C 83·5	H 11·3
C 83·4	H 11·5

According to *Dingler's Polyt. Journal*, Soubeiran found:—

C 87·8	H 12·2

This also is read in the *Handworterbuch der Chemie erste Auflage*, bd. iii., p. 747; and the same again occurs in Liebig and Kopp's "Jahresbericht," bd, p. i. 744. Dr. Douglas Maclagan, who also analysed gutta percha found:—

C 86·36	H 12 15	O 1·49

There is, therefore, a considerable discrepancy between the figures found as results of the elementary analysis of this substance. I have made several elementary analyses of this substance, both in a rough state and purified,—viz., by chemical means,—and I found very different results for different or differently-treated substances, although they were all gutta percha.

I obtained from the manager of Munnich, Beek, and Co.'s works a piece of gutta percha pure white as ivory, rolled into sheets, and used by the firm to print [1]some of their address cards on. This piece had been found inside a large lump of gutta percha, and, as it was discovered on dividing the large block into slices, it was at first thought to be an adulteration. It proved to be pure gutta percha. I tested it and found it to possess all the characteristics of the good genuine article. After having been dried over sulphuric acid until no more loss of weight followed, I made an elementary analysis of it and found :[2]—

C 87·91 H 11·94

It also contained a trace of nitrogen and ash, the former detected by Lassaigne's test, carefully executed, and compared at the time with pure sugar, submitted to the same test.

A sample of rough gutta percha, dried as described, and also dried at 100° C., for a considerable time, with the aid of a current of dry air, gave as an average of two analyses :—

C 83·07 H 10·96

This sample also contained nitrogen in more than traces. However, I did not estimate the amount. The same substance, after having been treated with boiling water, cold and boiling alcohol, and then with ether, was dissolved in pure chloroform, the solution filtered, and then precipitated by alcohol, washed with boiling alcohol, and dried over sulphuric acid,[3] and at 100° C., gave as mean for three analyses :—

C 86·44 H 11·37

There was no more nitrogen detected in this substance by Lassaigne's test, but there remained a small quantity of ash.

It is now-a-days not unknown that neither caoutchouc nor gutta percha are such inalterable substances as they were once thought to be. Payen, in the latest edition of his "Précis de Chimie Industrielle," calls attention to this important fact. I am fully convinced of the truth of his assertions; and, as evidence of this truth, I mention the following facts :[4]—A portion of gutta percha was treated by me, first, with boiling water, then with boiling alcohol and with ether, and dissolved in pure rectified oil of turpentine, purposely re-distilled over caustic lime. I filtered the solution and precipitated the gutta percha with alcohol. I thus obtained a beautiful pure white precipitate. In order to get it free from adhering oil of turpentine, I boiled it (the pure gutta percha) with alcohol, and washed it with boiling alcohol. It was then put in a bottle and kept there while a portion was dried over sulphuric acid. After a very long time—many months—I made an elementary analysis of it, and, in trying to divide it into small, suitable fragments, found, to my astonishment, that the gutta percha had got quite brittle, and obtained a yellowish colour. It could be almost powdered in a mortar. It gave as the result of elementary analysis :[5]—

C 71·09 H 8·37 O 20·44.

There was no nitrogen, but a small trace of ash. The bottle in which this sample had been kept gave off, when opened, a very strong, somewhat acrid smell. On treating a small quantity of the gutta percha so changed with water, the latter gave evidence of a distinctly acid reaction to test-paper.

Caoutchouc undergoes a similar change, but less rapidly, and when vulcanised withstands very long. I had an opportunity of analysing a sample of caoutchouc which was, at least partly, readily reduced to powder, after having been dried for months over sulphuric acid. As the average result of two analyses I obtained

C 78·25 H 10·34 O 11·40.

This sample contained nitrogen, but its quantity was not determined. When experimenting with both these substances, and some others belonging to the same class, I found that after having been placed in very dry air during some weeks they lost their most prominent physical properties, and a change set in which Payen compares with the growing rancid of fats and oils. Perhaps the decomposition starts from that constituent portion which contains nitrogen, although this element is present only in minute quantity. I am sorry it did not occur to me to test the air with which these substances were enclosed in a well-closed exsiccator, for the presence of a larger quantity of carbonic acid. I could add here a good deal more about gutta percha and caoutchouc, but leave this subject now to give, perhaps afterwards, something more interesting to many of your readers than my experiments here treated of, from the untranslated works of the celebrated Mulder, who writes in a language which is not generally spoken nor taught.

On the Optical Properties of the Picrate of Manganese,[6] *by* M. CAREY LEA.

BREWSTER and HAIDINGER have described a remarkable property possessed by certain crystalline surfaces, of reflecting, besides the ray normally polarised in the plane of incidence and reflection, another ray, polarised perpendicularly to that plane, and differing from the former in being coloured, a property rendered more conspicuous by the fact that the colour of the ray so polarised abnormally is either complementary to, or at least quite distinct from the colour of the crystal itself.

I find that this property is possessed to a remarkable degree by the picrate of manganese. This salt crystallises in large and beautiful transparent right rhombic prisms, sometimes amber-yellow, sometimes aurora-red, exhibing generally the combination of principal prism, and macrodiagonal, brachydiagonal and principal end planes. In describing this substance in a paper on picric acid and the picrates, I mentioned that in a great number of specimens examined, no planes except those parallel with or perpendicular to the principal axis had

[1] This white gutta percha answered very well for the purpose of lithography.

[2] This result obtained by me agrees with the average result of three analyses made of gutta percha (Indian or Oriental) by Dr. Oudemans, at Utrecht, now about two years ago. He found as the average of his three analyses C 87·91 H 11·9. (See *Répertoire de Chimie Appliquée*, t. i. p. 455.)

[3] I applied two methods of drying, viz., by heat at 100° C., with a current of dry air, and over sulphuric acid,—a very slow process, but very commendable in many cases.

[4] The practical bearing hereof should be kept in mind where gutta percha is used as belts, in mills and other works, and also where it is used for surgical instruments, which may suddenly give way.

[5] Average of three experiments.

[6] Read before the American Association for the Advancement of Science at Newport, August, 1860; *American Journal of Science and Art*, November, 1858.

been met with. Since then I have obtained in several crystallisations specimens exhibiting a brachydiagonal doma, but this appears to be rather unusual.

The optical properties of this salt are very interesting. It exhibits a beautiful dichroism. If the crystal be viewed by light transmitted in the direction of its principal axis, it appears of a pale straw colour, in any other direction, rich aurora-red in some specimens, in others salmon colour. A doubly refracting achromatised prism gives images of these two colours, except the light be transmitted along the principal axis of the crystal of picrate, in which case both are pale straw colour.

But it also possesses in a high degree the property of reflecting two oppositely polarised beams, and the great size of the crystals in which it may readily be obtained, renders it peculiarly fitted for optical examination. If one of these crystals be viewed by reflected light while it is held with its principal axis lying in the plane of incidence and reflection, the reflected light is found to be not pure white, but to have a purple shade. Examined with a rhombohedron or an achromatised prism of Iceland spar, having its principal axis in the plane of incidence and reflection, the ordinary image is white as usual, while the extraordinary is of a fine purple colour, the phenomenon having the greatest distinctness when the light is incident at the angle of maximum polarisation.

The experiment may be varied and the purple light beautifully seen without the use of a doubly refracting prism by allowing only light polarised perpendicularly to the plane of incidence to fall on the crystal; in this case the surface of the crystal appears rich deep purple, no white light reaching the eye.

This property is not possessed by all the planes of the crystal, but is limited to the principal prism and brachy- and macro-diagonal end planes, in other words to the planes parallel with the principal axis of the crystal. The brachydiagonal doma and $0P$ planes do not possess it. Nor is it exhibited by the first-mentioned planes, when the crystal is turned with its prismatic axis at right angles to the plane of incidence.

All specimens of picrate of manganese do not possess this property to an equal extent. The crystals vary considerably in colour, and those which are full red exhibit it more strongly than the amber-coloured. Picric acid boiled with aqueous solution of cyanhydroferric acid, and saturated with carbonate of manganese, gives crystals of a rich deep colour, which exhibit the purple polarised beam particularly well.

These properties are not possessed by the manganese salt alone, but also by the picrates of potash and ammonia, (especially when crystallised by very slow spontaneous evaporation in prisms of sufficient size,) and the picrates of cadmium and peroxyde of iron—with this difference, however, that while the prismatic axis of the crystal in the case of the cadmium and manganese salts must be in the plane of incidence, in the alkaline salts it must be perpendicular to that plane. As they all crystallise in the right rhombic system, it is probable that either the alkaline salts on the one hand, or the manganese and cadmium on the other, are prismatically elongated in the direction of a secondary axis.

It is convenient that distinct phenomena should have distinct names, and none appears to have been assigned to this. Brewster speaks of it as a "property of light," and Haidinger uses the word "Schiller" for it. The terms dichroism, trichroism, and pleiochroism, are limited to properties of transmitted light. I therefore suggest for that here in question the name *catachroism*, using the preposition κατα in the same sense as in the word κατοπτρίζω, to reflect, (as a polished surface,) applying it to express the property of reflecting two beams, one normally polarised in the plane of incidence, and the other polarised in a plane perpendicular to it.

The chromatic properties exhibited by the picrates of ammonia and potash are very remarkable in their variety. Their crystals possess:—

1st. The well-known play of red and green light. If a little very dilute solution of pure picrate of potash be spontaneously evaporated in a hemispherical porcelain basin, so as to form a net-work of extremely slender needles, and these be viewed by gas-light, the play of colours is singularly brilliant.

2nd. Dichroism. When by spontaneous evaporation of large quantities of solution of potash, or better, of ammonia salt, transparent prisms of $\frac{1}{12}$ to $\frac{1}{10}$ inch diameter are obtained, these, viewed with a doubly-refracting prism by transmitted light give two images, one pale straw colour, and the other deep brownish red.

3rd. The above-described property of catachroism, or reflection in the plane of incidence of oppositely polarised beams.

TECHNICAL CHEMISTRY.

On the Manufacture of Oxygen, by MM. H. ST.-CLAIRE DEVILLE *and* H. DEBRAY.

COMMISSIONED by the Russian Government to study the dry treatment of platinum ore, and the revivification of this precious metal by fusion according to the new metallurgic processes proposed by us, we have directed our later researches to the economical preparation of oxygen; and feeling convinced, from the point to which we have brought this question, that manufacturing industry, either as regards lighting or the working of metals, will derive benefit from our experience, we extract from the report addressed by us to the Russian Minister some brief details respecting the wholesale manufacture of pure oxygen.

We have experimented on large quantities of oxygen, and have successively extracted it from the following materials, viz., manganese, chlorate of potash, chloride of lime, nitrate of soda, nitrate of baryta, binoxide of barium, sulphate of zinc, and sulphuric acid. We will confine our remarks here to the last two substances, which are employed for the first time to our knowledge in the extraction of oxygen. We will first mention that we have repeated on considerable quantities of binoxide of barium the process of M. Boussingault, and have obtained the same results as that gentleman, though meeting with some practical difficulties, which, however, can easily be surmounted in a manufactory as soon as baryta by M. Kuhlmann's operations can be supplied commercially in sufficient quantities, and at a low rate, in the anhydrous state. It can then be easily and economically utilised for the production of oxygen.

Sulphate of zinc, which can be obtained in such large quantities by the action of the galvanic pile, is a substance not much in use at the present time; all its elements may be utilised in the following manner:—By calcining it alone in an earthen vessel it is transformed into a light, white oxide, which, when the sulphate is pure, can be used in painting; into sulphurous acid, which is collected in a concentrated solution, or as a sulphite, which is now applied to numerous purposes

and, lastly, into pure oxygen. The complete decomposition of sulphate of zinc does not require a much higher temperature than for the decomposition of manganese; it can be completely transformed into oxide of zinc and into a mixture of water, sulphurous acid, and oxygen. These are separated by the process which will presently be described for the preparation of oxygen by sulphuric acid.

Sulphuric acid decomposes at a red heat into sulphurous acid, water, and oxygen, in a very simple apparatus; a small retort, holding five litres filled with thin leaves of platinum,[1] or, better still, a worm of platinum filled with sponge of this metal and made red-hot. Introduce into it by an S-tube a small stream of sulphuric acid, issuing from a vessel at a constant level. The gases which escape pass first through a refrigerator, which separates the water from them, and then into a washer, of a special form, which it is here unnecessary to describe. Pure inodorous oxygen and a saturated solution of sulphurous acid are the constant results. If the washing-water is replaced by lixivium of soda, bisulphite of soda, saturated with sulphurous acid, is obtained, which can be neutralised by carbonate of soda, and transformed into neutral sulphite or hyposulphite.

If the water charged with sulphurous acid is passed into the generator which feeds the lead-chambers in a sulphuric acid factory, the sulphurous acid will be transformed into sulphuric acid at the expense of the atmospheric oxygen. We have calculated that it would suffice to burn in the sulphur furnace of a sulphuric acid apparatus double the quantity of sulphur contained in the concentrated solution of sulphurous acid in order to entirely utilise the latter gas, so that with one apparatus, without sensibly augmenting the expense, we could appropriate a third part of the sulphuric acid which it produces to the preparation of oxygen. As to the net cost, calculated on these data, it is so slight that it is impossible to give the exact figure or even an approximation to it. In fact, we have only to reckon as cost the very little coal required to maintain a small apparatus at red heat, and the nitrate of soda employed to determine the union of the atmospheric oxygen with the sulphurous acid; for our process consists really in taking oxygen from the air. Moreover, supposing the sulphurous acid proceeding from the decomposition of sulphuric acid to be lost, yet this sulphuric acid still remains the most economical agent for the production of oxygen, which does not cost 70 centimes for a cubic mètre when crude acid is used, and which is, therefore, in this respect, far superior even to binoxide of manganese.—*Comptes-Rendus.*

PHARMACY, TOXICOLOGY, &c.

New Process for the Preparation of Valerianate of Ammonia, in Dry Crystals, by Benjamin J. Crew.

Having experienced, along with many others, considerable difficulty in obtaining crystallised Valerianate of Ammonia, in quantity, by any of the published formulæ, I was induced to make a series of experiments, which, having been entirely successful, I am willing to make public for the benefit of other operators.

The first step in the preparation of this salt is to procure the monohydrated valerianic acid, or the oily inflammable acid. The terhydrated acid will not produce crystals under any circumstances, or with any amount of manipulation; a very dense solution may be had, but it will not crystallise, even if the temperature be reduced to zero. To procure the monohydrated acid, take of valerianate of soda a convenient quantity, say 5lbs., boiling water just sufficient to dissolve, strain the solution through muslin, if necessary, and add oil of vitriol by degrees until no further action is induced, or until the valerianate of soda is entirely decomposed. Allow the mixture to stand a short time, that the valerianic acid may rise to the surface and separate into a distinct layer, which may be drawn off with a syphon, separating funnel, or pipette. This acid (which still contains sufficient water to prevent perfect crystallisation) should be poured into a cylindrical jar, and treated with a small portion of oil of vitriol, and agitated by inserting a tube through the acid and blowing with the mouth; the passage and regurgitation of the air-bubbles mixes the whole thoroughly; allow the mixture to stand a few minutes; the oil of vitriol seizes the water and subsides with it. Now test with a hydrometer the supernatant acid, and should it mark a specific gravity of ·950, this part of the process is complete; if above this, add a second portion of oil of vitriol, which should bring it to this degree of strength. The acid, after thorough subsidence may now be drawn off by either of the processes above indicated. As thus prepared it is somewhat coloured, contains a small portion of sulphuric acid, and also a portion of water. From these impurities it is freed by distillation from a glass retort. In this process there are a few points to be attended to upon which perfect success must depend. The distillate should be received into a hydrometer jar, and each portion tested with a hydrometer. The first portion that comes over contains considerable water, and must be rejected and laid aside for further manipulation; when the distillate marks ·940 it may be retained. The distillation is now proceeded with, producing a portion of acid of ·930, until white vapours appear in the retort, when the gas flame is immediately withdrawn. The portion coming over first should be treated with oil of vitriol, the water abstracted and added to the retort, and the operation finished with care. The mixed distillates indicate a specific gravity of about ·933, perfectly clear, colourless, and of high refractive power. When thrown into water, it rises immediately to the surface, floating like an oil, burns with a blue flame, and acts with much energy upon the tongue and lips, producing a white spot and destroying the cuticle. The next stage of the process is far more simple and easy of execution, and consists in the saturation of the acid with dry gaseous ammonia, prepared by heating, in a suitable vessel, hydrate of lime and muriate of ammonia, in proper proportions, and passing the gas through a bottle containing fragments of quick lime. Ammonia is passed in until litmus-paper is not acted on. No attention is paid to keeping the acid cool. The temperature rises to about 150°, keeping the liquid thin, and thus preventing the stoppage of the tube with crystals. It should then be set aside to crystallise. In a few hours it becomes nearly or quite solid. If necessary, the crystals may be thrown upon a funnel, and allowed to drain, and finally laid upon bibulous paper. As thus prepared, they are perfectly snow-white, perfectly dry, and not deliquescent. Some specimens exposed to the air for several days appeared to effloresce.—*American Journal of Pharmacy.*

[1] In larger vessels the leaves of platinum may be replaced by pieces of brick.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On Food, by Edwin Lankester, *M.D., F.R.S.*

Lecture III. *On Starch and Sugar.*

(*Continued from page* 309).

I come now to speak more particularly of the Fuel which we use for the maintenance of heat,—that fuel is our food, and it is to the nature of that food, or some portion of it, that which I wish to call your attention to-day. There are several substances which are capable of acting in this way: their chemical history has been studied with much attention, and it has resulted in the application of a larger number of substances than the public generally reckon as affording a means of maintaining this temperature. But I will call your attention to them under the names of starch, sugar, and fat.

There are varieties of starch, varieties of sugars, and varieties of fats, and I shall have incidentally to allude to most of these, but they are sufficiently obvious in all their relations to be easily understood. The insolubility of starch, the sweetness of sugar, and the insolubility of oils, and their appearance is sufficient to characterise them. Every child knows the difference between bread, fat, and sugar.

I will, then, first call your attention to starch; and, in the first place, I would just endeavour to impress upon you the fact that this starch is not merely the substance which is used for domestic purposes for starching linens and so on, but that it is a substance which is universally present in plants, and that there is very little of our vegetable food that does not contain a larger or smaller quantity of it. I would draw your attention first, then, to its physical property. This starch, when we come to examine it as it exists in plants, is found to assume a granular form, but these granules are so small that they cannot be seen with the naked eye, and you may take any of these forms of starch, and you will be unable to see the minute particles, but if you put them under the microscope you will see their forms displayed in many ways. I have here a series of starches, every one of which enters into diet to a great or less extent; they all have a particular form—a granular form; sometimes this form is very simple, at other times the granules are united together so as to combine and form compound starch. These granules can be seen under the microscope, and, as they exhibit a coloured cross under the influence of polarised light, they are amusing as well as instructing. When we come to study them more closely we find that these starch granules appear to be composed of bags containing the true starchy or amylaceous matter of the starch. When they are submitted to the action of sulphuric acid they expand, and it is in this way that we ascertain that there is a delicate bag on the outside of the granule containing in the interior the true starch or amylaceous matter, together with a little silica and a little potash, and also a certain quantity of nitrogenous matter which cannot be got rid of. But these things do not constitute one per cent. of the starch of any of the plants that we are acquainted with, so that for dietetic purposes we may regard starch as a definite chemical compound, of which we shall have to speak presently. Now, starch is insoluble in water, and it is upon this principle that it is separated from substances in which it is contained. If I take a potato, for instance, and scrape it, and put a little of the scrapings into water, I shall find that a portion of the potato will fall to the bottom, but that the starch will be suspended in the water; and supposing I was preparing starch for dietetic or commercial purposes, I should take advantage of the sinking of the harder parts, and pour off the upper or supernatant liquor, and then I should obtain the starch. Thus starch is diffusible in water, but not soluble in it; that is the difference between it and the substance in which it is contained. If you look at a fragment of potato under the microscope, you will see that it consists of a series of cells of various forms, and in those cells you have the starch granules. Now, these cells are composed of a substance which is analogous to the wood of which this table and this board is composed. It is, in fact, the wall of the cell, and the cell-walls of the plants are always composed of this matter—*cellulose*, or *lignin*, as it is sometimes called. This is always present in our food. If you take any kind of wood, you will find that there is in it a quantity of what is called woody fibre; of that woody fibre, or cellulose, there are three-quarters of an ounce in a pound of potatoes; and we find it even in wheaten flour, and all the ordinary preparations of vegetable food. It is not, however, capable of being digested, or acting as food. It is one of those substances which I call accessory to the real food; it is not to be rejected in all cases; it may sometimes disagree by its indigestibility, but it is not always advisable to throw away this cellulose.

I now come to speak of the chemical properties of starch. I have hitherto been speaking of its physical properties. Starch is coloured blue by iodine, and I do not know anything else which is coloured so deeply as starch by the agency of iodine, so that we thus have the means of detecting its presence very easily. Not only can we detect it thus in food, but we can also detect it by the aid of the microscope. In structures of doubtful character we add iodine, and can thus detect the presence of starch. Now starch consists of carbon and water. I have before spoken of carbon entering into the composition of alcohol; carbon is found in all vegetable and animal matter, and, when the carbon is left after burning, we call it charcoal. Now, the composition, then, of starch is carbon 12 parts, and hydrogen and oxygen in the proportions in which those elements form water, 8 parts. If we calculate, then, the quantity of carbon and the quantity of water contained in starch, we shall find that every 144 lbs. of this starch contains 72 lbs. of charcoal. Here, then, is the source of this heating power. When we are taking starch in sago, arrowroot, or any other form, we take this proportion of fuel; and just as we heap charcoal on an ordinary fire, so, when we eat starch, we put fuel into our bodies, and carbonic acid gas is the result. However, I should be sorry to lead anyone to imagine that they could live on charcoal alone, or that charcoal would be good for breakfast or dinner; the fact is, that charcoal cannot be digested, and, before you can consume your charcoal, you must digest your starch. Now, starch itself is not digestible; that is, it is not soluble in water; and, therefore, it never goes into the blood. The fact is, that starch, before it is used in the system, is converted into sugar, and unless the starch of our bread, or of all our puddings, is converted into sugar, it will not be converted into blood at all. One of the curious properties of starch is, that, when you submit it to the action of certain substances, it will be converted from starch into sugar, and these substances are called ferments. You know when we want to change sugar into alcohol we add a ferment. If we want to convert the starch in our bread into sugar, we likewise require a ferment, and all the change which the starch undergoes is that, instead of having 8 atoms of water, it gets 12 atoms, for sugar is only starch with a little more water chemically combined with it. This sugar is constantly occurring in the Vegetable Kingdom. It is in the potato, it is in rice; in sweet potatoes there are large quantities of sugar, and carrots also have large quantities. Now we are provided within our mouths with a substance capable of converting starch into sugar. It is secreted in the saliva, and is termed salivine, or ptyaline. The moment we take starch into the mouth, and the saliva mixes with it, it is

converted into soluble sugar, and that is the way the starch finds its way into the system.

Before proceeding to speak of sugar, I will just point out a few sources of starch. In this substance which we call sago,—in this which we call tapioca,—and in this, the most common source of arrow-root, we have almost pure forms of starch. Various plants are employed for the production of starch. This arrow-root plant, which grows in the East Indies and in the West Indies, is bruised in water, and the supernatant liquid is allowed to stand when the starch is deposited. Here is the *Janipha Manihot*, containing poisonous hydrocyanic acid. The natives pierce it, and allow the poisonous juice to drop through; with this they poison their arrows, and then they use the bulb for preparing tapioca. Starch is also separated from rice, and rice-starch is sold for purposes in the arts and manufactures as well as of diet. Here I have a beautiful preparation of starch from the Indian maize, recently introduced to the public. The gluten and the husk is separated, and the beautiful starch thus prepared is sold under the name of "corn flour;" it is superior in many respects to arrow-root, and yet it is sold at a much lower price. Where starches are properly prepared, especially from maize, persons could not tell the difference between them and the finest arrow-root. I would just say there are some plants which on account of the large quantities of starch, and small quantity of nutritious matter which they contain, ought to be eaten only for the sake of the starch. Rice, for instance,—every 100 lbs. containing 92 lbs. of starch, with only a very small quantity of nutritious matter. It is, therefore, not prudent for persons to feed entirely upon rice. It should be eaten as a starch only, and not in any way as a nutritive article of diet. There are, also, a series of plants known under the name of sea-weeds. Some of these contain a peculiar kind of starch called lichenine, from its being found in lichens; and this is the reason they are employed as articles of diet.

Now I come to speak of sugar; I have told you how readily starch is converted into sugar, and you will not, therefore, be surprised to find sugar present in the same places that we find starch. But we find in some cases large quantities of sugar where we find no starch. Take, for instance, the carrot and the sweet potato. We find sugar more generally contained in the juices or the sap of the plant, than in any other form. Sugar has the remarkable property of fermentation, and it is during the process of this change of sugar that alcohol is produced, therefore you see we can make alcohol from starch, but we must first convert the starch into sugar, and I now call your attention to the chemical composition of sugar as being of the same kind as starch. I have here some sugar, and I will submit it to the action of a substance that will draw away the water, and leave the carbon to act freely. I first dissolve it in warm water, and will then pour upon it some sulphuric acid, and this will withdraw a sufficient quantity of water for you to see that the sugar contains a large quantity of charcoal. You see, now, what a large quantity of charcoal is developed from this sugar—there it is black, boiling, and hard from the action of the sulphuric acid. It is thus that we can demonstrate the presence of the charcoal, and in this way that very useful material, which we call blacking, is manufactured. A quantity of sugar is taken and sulphuric acid is added, and you see in what a shining state the carbon is left when it has been submitted to this process. In this way you see we can prove that the starch contains the same material.

Let me now call your attention to the history of the plant in relation to the sugar. During the germination of plants sugar occurs in great quantities. If we throw these seeds into the ground, the little embryo in the interior grows, and that process is called germination. There is a large quantity of starch surrounding this little embryo, and as it grows the starch is converted into sugar, and this starch is as necessary for young plants as it is for young children. Now this is the case, on a very large scale, in the process of malting. The maltster takes his barley, immerses it in water, causes the seed to germinate, and then he roasts the young plant, seizing the sugar which it has just made, and converts it into beer. Then again we find the stems of plants in certain seasons of the year contain large quantities of sugar; thus, the whole of the grasses, wheat, barley, oats, rye, rice, and maize, contain sugar in their stems when they are about to flower; and it is just at this season of its development that the sugar-cane is used by man as an article of diet. We need not, however, confine ourselves at all to the sugar-cane. The only reason why we get sugar from nothing else arises out of our fiscal system, revenue being obtained from it, and sugar not being allowed to be grown in this country. In China they obtain sugar from the *Sorghum saccharatum*, which, like the sugar-cane, belongs to the family of grasses, and is cultivated in the North of China for the sugar it contains. Then the maize has been cultivated in America and Mexico for the purpose of obtaining sugar. When Cortes conquered Mexico he found the natives cultivating the maize and crushing it for sugar. The cocoa-nut tree of the island of Ceylon is a principal source of sugar, and there are a class of men whose occupation it is to ascend these trees and put on the blossoms of the tree a calabash, to catch the exuding juice, which is an article of diet in Ceylon, as toddy, the men being called toddy-drawers. Again, at the budding season, the sap of plants contains sugar. The common osier has it. The birch, too, in England and Scotland is tapped for its sugar, and is converted in Scotland into an effervescing wine, exactly like champagne. In America there is a plant which contains so large a quantity of sugar that I think a third of the sugar consumed in the United States is obtained from it. It is the maple. Then the beet-root, the carrot, and the turnip contain sugar. When Napoleon Bonaparte excluded cane sugar from the French markets, they set to work to supply the loss, and adopted a German process, which resulted in the production of a very successful sugar from the beet-root; and now, after years of production, the beet-root sugar manufacturers are enabled to compete with the manufacturers of sugar from the sugar-cane. There is also another source of sugar in the fruit which we eat,—the fig, the pear, the apple, and the orange, would be unpalatable but for their sugar.

I will now draw your attention to the different kinds of sugar. Although sugar is always sweet, and we call everything that is sweet sugar, yet there are various kinds of sugar. Sugar is obtained from milk; and we can, by taking the livers of animals and digesting them in water, obtain large quantities of sugar called liver-sugar, showing that animals have the power of producing or secreting sugar. Thus we have several kinds, and I would just call your attention to the four principal sources.

The cane sugar is found in the stems of plants, and in all those cases where it is procured before the flowering of plants, and in the roots of plants; so that the beet-root sugar and the ordinary sugar that we eat from day to day is cane sugar. But we obtain another sugar from fruit, which is uncrystallisable; and that fruit sugar is almost identical with another, which is called starch sugar; and fruit sugar and starch sugar are both known to chemists by the name of Glucose. The cane sugar is called Sucrose, and the sugar obtained from milk is called Lactose, while liver sugar is called Hepatose. Those are the four sugars. I told you just now that the liver contains a quantity of sugar: I may say that I believe it has been demonstrated that the liver does not contain sugar itself, but a matter which is easily converted into sugar; so that the instant you expose it to the air it becomes converted into sugar. We have in glucose a substance much more easily decomposed than the other forms of sugar; and I will finish by

stating that this cane sugar is converted into this form of sugar, and then we have either glucose, lactose, or hepatose in the system. It is in that manner that the starch is converted into sugar, so that it becomes a heat-giving substance capable of maintaining heat in the animal body.

In the next Lecture I shall treat of Oils and Fats, which are also capable of producing and maintaining heat in the animal body.

PHARMACEUTICAL SOCIETY,

Wednesday, December 5, 1860.

T. N. R. Morson, *Esq.*, *President*, *in the Chair.*

The first paper read was "*On some Applications of Glycerine*," by Mr. G. Wilson. The author commenced by relating the history of the discovery of Glycerine by Scheele and by Chevreul, and then passed to its practical applications. The first therapeutical application was made in 1844 by Mr. W. De la Rue, who applied it to a burn, and finding its use beneficial, recommended it to Mr. Startin, who has since used it extensively in the treatment of diseases of the skin. In 1846, Mr. Warington took out a patent for preserving animal and vegetable substances by means of it. Mr. Wakley afterwards used glycerine as a remedy for deafness. M. Cap was the first who employed it in the preparation of medicinal compounds. He found it extremely useful in effecting the solution of many substances, which were insoluble, or but sparingly soluble, in water. Morphia he found dissolved in glycerine in all proportions,; and quinine, in the cold, formed with it a kind of cerate. Dr. Crawcour, of New Orleans, afterwards introduced glycerine as a substitute for cod-liver oil. The author then described the process by which a very pure glycerine is obtained at Price's Candle Manufactory. Palm-oil is subjected to the action of heat and steam under great pressure, when at a temperature of from 560° to 600° F. the fatty acids take up an equivalent of water, and glycerine takes up an equivalent of water, and both distil over together. The only point which requires attention in this process is the due supply of steam and water, for if these be not present in sufficient quantity acroleine is formed. In the above way glycerine is obtained of the specific gravity 1·24, which contains 94 per cent. of anhydrous glycerine. This is further concentrated to the sp. gr. 1·26, which has 98 per cent. of the anhydrous body. The author then proceeded to suggest a variety of purposes to which glycerine might be applied in pharmacy. The first was in the preparation of a concentrated Mistura ferri composita. Carbonate of potash, and sulphate of iron, may be dissolved in separate portions of glycerine, and then mixed; the carbonate of iron produced is dissolved at the moment of its formation, and will keep unchanged for any length of time. A sample of the solution exhibited had been made four years, and presented no appearance of change. When required for the mixture, the necessary proportion of the solution (which can be made of any strength) is added to the other ingredients. The carbonate of iron is precipitated when the solution is mixed with water. Glycerine had also been recommended as a substitute for sugar in the preparation of the syrup of iodide of iron, but in this case its use had been found rather disadvantageous than otherwise. The author thought, however, that solutions of the following substances in glycerine might be found of great use:—Ammonio-citrate of iron eight grains to the fluid drachm, and citrate of iron and quinine two grains to the fluid drachm. A solution of two grains of disulphate of quinine in a fluid drachm of glycerine might also be thought be useful, seeing no acid was necessary to effect the solution. Quina might also be dissolved to the extent of one grain in a drachm, and tannin to the extent of eight grains in a drachm. In the last case the glycerine prevented the decomposition to which tannin was liable in aqueous solution. The author also suggested the use of preparations of senna and rhubarb eight times the strength of the Pharmacopœia infusions. In these preparations no alcohol was required for their preservation. Solutions of essential oils, such as cloves, cinnamon, and lemon, might also be made with glycerine in the place of spirit. It could also be used to preserve fresh lemon-juice, and generally in the preparation of pills and confections.

Mr. Waugh inquired whether in the case of the Mistura ferri composita the mixture kept better than that made in the usual way, for if not he did not see the advantage of the concentrated solution.

Mr. Hills said no allusion had been made to the solubility of arsenious acid in glycerine. He had found it dissolved readily to the extent of a drachm in a fluid ounce.

Mr. Brady said such a solution had been in use, but it had been found that fungi grew rapidly in it.

Mr. Haselden pointed out a number of useful applications of glycerine. Gallic acid dissolved in it freely. Aloes, the resinous and other portions, completely dissolved; but a pure resin, such as scammony, was not soluble. A tincture of kino made with equal parts of glycerine and spirit, in which the kino was perfectly soluble, kept well and did not gelatinise. Borax dissolved freely in glycerine; and it might therefore be used in the preparation of tincture of myrrh and borax, which would really contain borax. Glycerine was valuable, too, in making solutions of vegetable extracts for external applications. In his preparations, Mr. Haselden said he used Price's glycerine condensed by Smith.

Mr. Squire asked if any member present had had any experience in the preparation of the so-called *Plasma*, made of starch and glycerine; what he had made had become mouldy.

The next Paper read was "*On Spermaceti Ointment*," by Mr. Barnes. Mr. Barnes's communication was occasioned by a statement made in the course of a former discussion on the same subject (see *Pharmaceutical Journal*, vol. xviii. pp. 259—356), that bleached olive-oil did not turn rancid sooner than unbleached, and was not more likely to provoke rancidity in ointments. The author held the contrary opinion, and in support of it he now exhibited specimens of the ointment he had prepared in October, 1858. Some were made with unbleached oil, and bleached and unbleached wax, and others with oil bleached by means of animal charcoal and bleached wax. These ointments had since remained in his shop, exposed to the same influences ointments usually are. In the course of three months those made with bleached oil had become decidedly rancid, while those prepared with the unbleached remained perfectly sweet. After two years, these were all boiled with water, when the author found that the water in which the bleached specimens had been boiled, had a decidedly acid reaction, while that from the sample made with unbleached oil and unbleached wax, showed no acid reaction at all. He therefore suggested that the Pharmacopœia Committee should recommend that spermaceti ointment be prepared with unbleached oil and wax. The author also stated, that in order to test the power of light in bleaching olive-oil, he had exposed two bottles of fresh oil for a long period, and found the colour quite unaffected, and he therefore concluded that light did not bleach olive-oil.

A long conversation followed the reading of this paper, which we have not space to report at length. Two points were principally discussed,—the bleaching of olive-oil by means of light, and the best composition for spermaceti ointment. On the first point two directly opposite statements were made by gentlemen who had tried the experiment, so it is fair to infer—the veracity of both being quite unimpeachable—that some olive-oil is, and some is not, bleachable. On the second it appeared that some

members used bleached and others unbleached olive-oil, while a few substituted almond oil. Some also employed lard, the use of which was condemned by others as contrary to the directions of the Pharmacopœia. With all this diversity of practice, however, there was a perfect unanimity of opinion that it was extremely desirable spermaceti ointment should be made everywhere alike.

A Paper "*On the Displacement Process*," by Mr. Sandford, followed. Mr. Sandford's paper may be summed up in a very few words. He is of opinion that the process of Percolation, or, as he prefers to call it, Displacement, recommended in the Edinburgh Pharmacopœia, is the best and simplest method of preparing tinctures and extracts, and that he who is not able to manage the process satisfactorily, is unworthy to be called a chemist. The only point raised for discussion was whether it was necessary or not to interrupt the flow of the menstruum so as to allow of maceration for limited periods during the operation.

Mr. Deane said the experience of twenty years had convinced him that it was necessary to regulate the flow, and he advocated the use of a tap at the bottom of the percolator for the purpose. In preparing aqueous extracts of poppy-heads and cinchona-bark, he showed that the specific gravity of the percolated fluid varied from hour to hour, and contended that without the use of a tap much more water would have been necessary to perfectly exhaust the materials. In the case of tinctures, he said, half the quantity of spirit was sufficient to exhaust the materials, and the rest might be added afterwards.

Mr. Squire said the question of Percolation was an extremely important one, and he proposed that the discussion should be adjourned until the next meeting, which was agreed to.

A Paper, by Mr. Schweitzer, "*On the Prevention of Accidental Poisoning*," was also deferred.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1860.

Dr. J. P. Joule, President, in the Chair.

A Paper by Thomas Moffat, M.D., F.G.S., F.R.A.S., "*On the Prevalence of certain Forms of Disease in connection with Hail and Snow Showers, and the Electric Condition of the Atmosphere*," was communicated by Mr. Binney.

In 1852, while deducing results from the meteorological observations of the two previous years, the Author observed that an intimate connection existed between falls of snow and hail and diseases of the nervous centres, such as apoplexy, epilepsy, paralysis, and vertigo; and the results of eight more years bear out the truth of the observation.

A table formed from two hundred and thirty-six cases of the above diseases, and upwards of one thousand observations of the electrometer, is given, showing the per centage of hail and snow showers, the cases of diseases of the nervous centres, and the times that the air was positive and negative with each wind. From this table it appears that with the wind from the N., N.E., E., and S.E. points, which the Author calls the snow points, the per-centage of hail and snow showers is 23·2; of cases of apoplexy, &c., 36·7; of positive electricity, 27·0; and of negative electricity, 34·1; while with the wind from the hail points, S., S.W., W., and N.W., the per-centages are respectively 76·6, 65·7, 72·6, and 67·5, thus showing that the number of cases of disease increases with the frequency of hail and snow showers, and the consequently increased frequency of the alternations of positive and negative electricity.

All observers agree that the air is negative on the approach of great storms, and negative—or alternately negative and positive—in unsettled weather, and the Author remarks that such storms are almost invariably accompanied by convulsive diseases, or diseases of the nervous centres in some form; and in support of his statement he quotes many cases from his notes of the storms of the last twelve months, but more particularly the succession of gales which occured from the 21st to the 30th of October, 1859 (in one of which the *Royal Charter* was lost), the gales of the 25th, 26th, and 27th of May last, which were accompanied with frequent hail showers; and those of the 24th of August and four following days. Other forms of disease accompany such atmospheric conditions, such as premature uterine action, epistaxis, and diarrhœa, with vomiting and cramps; and cases of this class are quoted by the Author from his notes; and he remarks that it would then appear that negative electricity plays an important part in the above atmospheric conditions and morbid actions. After describing the electrical phenomena of continued heavy rains, and of thunder storms and heavy showers of hail and snow, the Author observes that as the electrical tension of the clouds which produce these storms and showers is always strong, it must have a coercive force upon all bodies at the earth's surface; and that as, according to our notions of electrical action, the moment the influence of the inducing body is removed, a re-arrangement of the electricities in the induced body takes place, we cannot well avoid the conclusion that during the period of induction, and when the re-arrangement—the rebound, the back stroke—occurs, some important action must take place in the organic forces, such as the nervous and the muscular. Cases are quoted in illustration, and the Author then remarks that from long series of observations it would appear that there is an intimate connection between hail and snow showers, stormy weather, atmospheric electricity, and certain forms of disease; and he ventures to add that hail and snow are formed under the influence of opposite electrical conditions, and concludes by suggesting the means of putting this opinion to the test of experiment.

MICROSCOPICAL SECTION.

November 19, 1860.

A Letter was read from Mr. R. D. Darbishire, relative to the deposits from the raised sea bottom found at Capell Backen, Uddevalla, near Gottenburg, in Sweden. He observes that "the hill side from a height of about fifty feet above the level of the sea to that of about two hundred and thirty feet, consists of layers of fossil shells, varying from ten to thirty feet thick, alternating with beds of more or less coarse gravel and clayey sand." Mr. Darbishire contributed, for the use of the Members, a parcel of washings from shells, and a box containing dry sieved soil for microscopical examination.

A Letter was read from Mr. John Hepworth, of Crofts Bank, describing his method of washing and mounting calcareous and silicious shells, dry and in balsam. Mr. Hepworth also presented to the Members of the Section, for mounting, a piece of injected kidney.

A Paper by Mr. J. B. Dancer, F.R.A.S., was read, "*On Cleaning and Preparing Diatoms obtained from Soundings and other Sources.*"

The Secretary exhibited a portion of sea-weed from the Gulf Stream, in which were found a few diatoms, remains of entomostraca, &c., contributed by Mr. A. da S. Lima, of London.

The Chemical Society. — The next meeting of the Chemical Society will take place on December 20. Papers will be read "On the Absorption of Gases," by Dr. Roscoe, and—"On Sugar in Urine," by Dr. Bence Jones.

NOTICES OF BOOKS, PATENTS, &c.

Lehrbuch der Organischen Chemie oder der Chemie der Kohlenstoffverbindungen. Von Dr. Aug. Kekulé. Zweite Lieferung. Erlangen: F. Enke, 1860. [Second Notice.]

In this second part of Professor Kekulé's work, the consideration of those questions of Physics which are more immediately connected with Organic Chemistry is completed. The subjects of specific volume, specific weight, and specific heat are treated with precision and at sufficient length. Perhaps a little more detail might have been given under the heads of boiling-point, melting-point, and latent heat. Two or three pages are devoted to an account of the absorption of gases by various liquids. The few words with which the important subject of Fractional Distillation is dismissed are quite insufficient. The optical properties of organic bodies, especially their relations to polarised light are here merely glanced at in the most cursory manner; they are not treated of with that amount of fulness or care which nearly all the other portions of the work present. This is the more to be regretted since the subject is one which has now begun to receive well-merited attention, and its study has already been rewarded by many discoveries. We can attribute the imperfect manner in which the last-mentioned subjects are handled only to a fear entertained by the author that the physical portion of his treatise had already extended over a quite sufficient proportion of pages. Out of about 960 pages, of which the completed work will probably consist, 307 being occupied with Chemical Physics.

The account of Organic Chemistry proper opens with a description of cyanogen and its compounds. The manner in which the author treats of the various substances which came under his notice, may perhaps be illustrated by the first series, which we quote:—

	Hydrogen type.
Hydrocyanic acid . .	$\overset{\prime\prime\prime}{C}N\,H$
Cyanogen . . .	$\overset{\prime\prime\prime}{C}N\,\overset{\prime\prime\prime}{C}N$
Cyanic chloride . .	$\overset{\prime\prime\prime}{C}N\,Cl$
Cyanuric chloride . .	$(C_3N_3)'''Cl_3$

	Water type.
Cyanic acid . . .	$\left.\begin{matrix}\overset{\prime\prime\prime}{C}N\\ H\end{matrix}\right\}O$
Sulphocyanic acid . .	$\left.\begin{matrix}\overset{\prime\prime\prime}{C}N\\ H\end{matrix}\right\}S$
Cyanuric acid . . .	$\left.\begin{matrix}(C_3N_3)'''\\ H\end{matrix}\right\}O_3$

	Ammonia type.
Cyananide . . .	$\left.\begin{matrix}\overset{\prime\prime\prime}{C}N\\ H\\ H\end{matrix}\right\}N$
Cyanuramide or Melamine	$\left.\begin{matrix}(C_3N_3)'''\\ H_3\\ H_3\end{matrix}\right\}N_3$

Nothing but an attentive perusal of the work itself will give any idea of the clear and beautiful way in which the constitutional relations and molecular equivalency of all the complicated double cyanides is made out. The following formulæ point out in an instructive manner the connection between four important cyanogen compounds, the constitution of which has been deemed unintelligible:—

Cyanuric acid	Melanuric acid.	Ammeline.	Melamine.
$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,NH_2$
$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,NH_2$	$\overset{\prime\prime\prime}{C}N\,NH_2$
$\overset{\prime\prime\prime}{C}N\,OH$	$\overset{\prime\prime\prime}{C}N\,NH_2$	$\overset{\prime\prime\prime}{C}N\,NH_2$	$\overset{\prime\prime\prime}{C}N\,NH_2$

Melam, $C_9N_{11}H_9$, becomes a pentamine:—

$$\left.\begin{matrix}(C_3N_3)'''\\ (C_3N_3)'''\\ H_9\end{matrix}\right\}N_5$$

Ammelide, $C_6N_9H_9O_3$, is formed on a type constituted by the coalescence of 3 molecules of NH_3, and 3 of H_2O:—

$$\left\{\begin{matrix}H_3\\ (C_3N_3)'''\\ (C_3N_3)'''\\ H_3\\ H_3\end{matrix}\right\}\begin{matrix}O_3\\ \\ \\ \\ N_3\end{matrix} \quad \text{or, more simply,} \quad \left.\begin{matrix}(C_3N_3)'''\\ (C_3N_3)'''\\ H_9\end{matrix}\right\}\begin{matrix}N_3\\ O_3\end{matrix}$$

Even hydromellonic acid, $C_9N_{12}H_3$, becomes intelligible when viewed as a tetranine:—

Hydromellonic acid $\left.\begin{matrix}(C_3N_3)'''\\ (C_3N_3)'''\\ (C_3N_3)'''\\ H_3\end{matrix}\right\}N_4$ Mellonides $\left.\begin{matrix}(C_3N_3)'''\\ (C_3N_3)'''\\ (C_3N_3)'''\\ M_3\end{matrix}\right\}N_4$.

The remainder of the second part is occupied with an admirable account of the monatomic alcohol radicals and their derivatives, and is so full of original observations, and points out in so satisfactory a manner the distinguishing marks of the main types among these bodies, that brief extracts would not do the author justice. We are sure that many of our readers will be glad to have their attention again directed to the original work.

Improvements in the Preparation of a Colouring Matter for Dyeing Textile Materials and Fabrics, and other Substances. John Dale.

This patent appears to us to be both chemically and commercially important. The principle involved is simple enough, and merely consists in extracting the colouring matters of the dye-woods with alkaline solutions, and re-precipitating by means of acids. The colouring matters of barwood, camwood, redwood, &c., are, as is well known, soluble in alkalies, and the alkaline solutions are of a much darker and more intense colour than the mere aqueous infusions. The alkaline solutions are, however, destitute of dyeing properties, and, moreover, any excess of alkali causes the colouring matter to undergo a chemical metamorphosis sufficient to permanently deprive it of tinctorial power. But, by regulating the strength of the alkaline solution used as a solvent, the colour may be extracted in its red condition, and free from the peculiar purple tint so familiar to all who have used log-wood as the test in Dr. Price's improvement of Peligot's modification of Will's process for determining nitrogen. The patentee uses pressure in extracting, and pumps the boiling alkaline solution through the woods. 120 lbs. of caustic alkali of 25 per cent., require 500 to 800 gallons of water for dilution before being sufficiently weak to prevent injury to the colouring matter. The patentee does not state from what weight of the different woods the above amount of fluid is capable of extracting the colour. That the quantities vary greatly with the nature of the wood is, however, plain. The patentee states that camwood contains more acid than the other wood, and, consequently, requires more alkali.

Improvements in the Production of Colours for Dyeing or Printing. (A communication from L. and E. Boilley Frères, of Paris.) John Henry Johnson.

This invention, which appears to us of great value, is for producing from indigo what the inventors term "purple blue." They prepare it from indigo by acting on it with,—1. Bisulphate of soda; 2. A mixture of ordinary sulphuric acid with anhydrous phosphoric acid; 3. A mixture of sulphuric acid and chloride of potassium. The first appears to be the best process: it is conducted as follows:—One part of finely-powdered and sifted indigo is gradually added, with constant stirring, to from ten to twenty times its weight of anhydrous bisulphate of soda in a state of fusion at a temperature of from 200° to 300° C. (= 392° to 572° F.) [Berzelius recommends preparing the bisulphate of soda by heating 10 parts of dry

sulphate of soda with 7 parts of monohydrated sulphuric acid, the temperature of fusion being kept up until the mixture flows quietly at a red heat.—Ed.] The fusion of the indigo with the acid salt is continued until the mixture colours water a violet red. The mass is then thrown into water (7 or 8 gallons to each pound of mixture), and well stirred. [Surely the solution should be filtered before proceeding to the next stage.] Two pounds of common salt are now added to the solution for every pound of mixture employed; and, as the solution cools, the colour is precipitated in an impure state. This "purple blue" only requires to be well washed to render it sufficiently pure for use. As it is soluble in water, a saline solution must be used for washing. The patentee recommends solutions either of common salt, chloride of potassium, or acetate of potash for this purpose. "It only remains to filter the liquid in order to collect the precipitate, and to dry the same after having removed the matters which are found on the surface. These matters, which are of a blackish or greenish colour, are of another nature, and being of a lighter weight, they will not be deposited until the liquid has been allowed to stand some time. The product thus obtained is in the form of small crystals." Does the patentee mean that the impurity, or the purple blue is crystalline? As it stands in the patent it would appear to be the impurity. The patentee does not give the slightest information as to the method of employing the colour in dyeing or printing. It is probably used in the same way as "carmine of indigo."

Time-Indicating Candles, &c. Gilbert Stanton Fleming, of New Oxford Street, London.

The first part of this invention consists in marking the candle so as to indicate the passing of time by the amount burnt The second part consists in tipping the wicks with an inflammable composition so as to facilitate their ignition. Surely in these days of cheap and good watches and clocks, no one would dream of employing this melancholy expedient for registering the flight of the arch-enemy. Moreover, among our schoolboy lore, we had a tradition that King Alfred used this method of dividing his time. The patent was not proceeded with, probably from a fear that the heirs or ghosts of Alfred, or his wax-chandler, might enter a *caveat*.

CORRESPONDENCE.

Medium for Mounting Microscopic Objects.

To the Editor of the Chemical News.

Sir,—Perhaps some of your readers, or correspondents, could point out a great desideratum to microscopists, namely, a substance that would destroy the muscular tissue and soften the chiture of insects steeped in it, and also combine with Canada balsam in the same manner as sulphuric ether, or turpentine, without interfering with its transparency.

Liquor potassæ and strong acetic acid are used at present to prepare insects, and they answer very well so far as removing the muscles and softening the hard tissues, but as they contain water they are objectionable; for though you can wash away all traces of the acid or alkali with pure water, yet you cannot get rid of the water without again hardening the tissues by drying, which of course spoils your specimen, for not only is it so brittle as to render it difficult to handle it, but the whole of spaces previously filled with muscles and the viscera, are now filled with air, and it is quite impossible to displace the whole of the air by balsam. Attempts have been, indeed, made to displace the water with turpentine without drying, with but partial success. So far as the final setting up in the balsam is concerned, as from the turpentine not freely mixing with the balsam at first, and the two occupying more space when separate than when united, little vacuities having the appearance of bubbles of air soon form and disfigure the object. I have been thus minute to show:—First, that it is essential that the substance contain no water. Second, that it be a perfect solvent of Canada balsam, and also of a suitably corrosive nature.

In conclusion I may add that it is advisable that it should be cheap and easily procurable.—I am, &c.

W. M. S——s, M.D.

On Numerical Relations Existing between the Equivalent Numbers of Elementary Bodies.

To the Editor of the Chemical News.

Sir,—An article signed "J. V." in a recent number of your journal, contrasting some observations of mine upon Numerical Relations Existing between Chemical Equivalents has attracted my attention. Will you do me the favour of giving a place to the following remarks in answer?

A writer, before attempting a criticism, should first acquire a general knowledge of the subject, and then make himself acquainted with the particular views which he intends to criticise. Whether "J. V." has done the former may be judged of by the fact that he classifies phosphorus between selenium and tellurium, asserting at the same time that its equivalent (31) is divisible by 8. He classifies magnesia together with lead, baryta, &c., as an *isomorphous group (sic)*. His placing hydrogen at the head of the chlorine series with the equivalent 19·18 is probably a typographical error[1]. Comment is superfluous.

He shows that the equivalent numbers of this new isomorphous group which he has formed, viz., magnesium, calcium, strontium, barium and lead, are more or less nearly approximate multiples of 4, while the equivalents of glucinum, aluminium, iron and manganese are approximate multiples of 7, from which considerations, he asserts, several of the relations which I have pointed out, proceed. I beg to say in answer, that if they did, it would be a matter of no importance whatever to the argument, but it happens that they do not. That they should do so, it would be necessary *that the multipliers in both cases should be the same;* in other words, that the numbers which multiplied by 4 give the one series, should, when multiplied by 7, give the other. But these multipliers are in the one case as given by him 3, 5, 11, 17 and 26, and in the other 1, 2, 4, 4, exhibiting not even a casual coincidence in a single instance. "J. V.'s" argument is, therefore, a complete *non sequitur*. It wants proof and is not to the point.

Even were the views taken by the anonymous writer in your columns perfectly correct, it would not justify him in departing from the tone of courtesy usual in arguments between gentlemen. Nor has a writer the right to criticise the observations from an abstract in another journal, which is of necessity a scanty one. Had "J. V." referred to my original paper, he would have seen that I did not (as he asserts) offer these geometrical proportions as the basis of a classification. In the present imperfect condition of our knowledge of the laws which govern the proportions in which bodies combine, anything which tends, however remotely, to refer them to exact ratios cannot be devoid of interest. I, however, especially called attention to the fact that they might often be devoid of real significance, even where most exact. It was my seriated groups, differing in the successive terms of each series by a constant quantity, and corresponding very faithfully with well-established chemical properties, which I believed to be worthy of consideration amongst

[1] H was a typographical error for Fl.—Ed. Chemical News.

the arguments for exercising an influence on classification. These series, and my views, will be found in *Silliman's American Journal* for January, 1860, and are concisely, but clearly, presented by Dr. Knop in his *Centralblatt* for May 9, 1860, and also (in part) in the Chemical News, and *Rép. de Chimie Pure et Appliquée*, for the present year.—I am, &c.

M. Carey Lea.

Philadelphia, November 20, 1860

On the Preparation of Non-conducting Surfaces for Electrotyping.

To the Editor of the Chemical News.

Sir,—Having been lately occupied in making some experiments in preparing non-conducting substances for electro-deposition by a chemical process, I send you the result, hoping it may prove useful to some of your readers.

For this purpose I prepared a sheet of gutta-percha as follows:—

1st. With a solution composed of equal parts of white of egg and a saturated solution of common salt in water, and dried thoroughly.

2nd. With a strong solution of nitrate of silver, and, when dry, I exposed it to light till quite black.

3rd. With a saturated solution of proto-sulphate of iron. This last produces a highly-conducting surface of metallic silver.

On attaching it immediately (before dry) to the wires of a battery, and immersing it in a solution of sulphate of copper, I obtained a very uniform and rapid deposit without the help of guiding wires.—I am, &c.

Bernard Piffard.

The Specimen Exchange Club.

To the Editor of the Chemical News.

Sir,—The utility (I was about to say necessity) of the proposed "Chemical Exchange Club" has been so well advocated in your pages, that I can only regret with "J. C. S.," that so little interest should have been taken in its formation.

It seems to me, however, that some difficulty would be experienced in deciding what does, and what does not, constitute a chemical or mineral "specimen."

Would it not be a good plan to divide specimens into a certain number of classes (say five or six), according to their exchangeable value, those of least value to go into Class I., and so on, in the order of their value?—and that it were acknowledged that a specimen belonging to one class might be fairly offered in exchange for one of the same class, or two of an inferior class, &c.?

I think, also, that it would be necessary to leave the estimation of the exchangeable value of the specimens to you,—subject, of course, to the consent of the owner,—who, if not agreeing to the estimate, should withdraw the specimen; otherwise, I fear, the exchange would be attended with interminable correspondence. If, as proposed by "Practice," money were accepted in exchange, you would also have to decide upon the value of the specimens, or else to attach a money value to each class of specimen. I think, however, that the exchange of specimens for money would be more appropriately effected at a chemical shop.

I sincerely hope that the Club may not be allowed to die a natural death.

I, for one, have many minerals and some chemicals which I should be but too glad to exchange for others, and which would, I think, belong to Classes I. to III.—I am, &c.

E. F.

Chemical Notices from Foreign Sources.

1. MINERAL CHEMISTRY.

Crystallized Aluminium Compounds.—Michel has made the following compounds in Wöhler's laboratory (*Annalen der Chem. und Pharm.* Bd. cxv. s. 102):—

Tungsten-aluminium.—Al_4 W. made by fusing together 15 grammes of tungstic acid, 30 grammes of cryolite, 30 grammes of chloride of potassium and sodium, and 15 grammes of aluminium at strong red heat. The excess of aluminium was extracted from the regulus by means of hydrochloric acid. Tungsten-aluminium is an iron-grey crystalline powder, single crystals being several millimètres long, brittle and hard. Under the microscope they appear to be rhombic prisms with not well-defined planes. Their specific gravity is 5·58. Cold concentrated acids do not attack the compound, but hot nitric acid oxidises it, with separation of tungstic acid. Hot hydrochloric acid dissolves it, giving a deep brown solution, and forming a compound of tungsten and chlorine. Hot soda ley extracts all the aluminium, and leaves behind pure tungsten.

Molybdenum-aluminium.—Al_4 Mb. Molybdic acid is dissolved in fluoric acid, the solution is evaporated to dryness, and the residue is mixed with cryolite, flux, and aluminium in the same proportions as above. The excess of aluminium is extracted from the fused mass by soda ley. There remains a black crystalline powder, the black colour being given by a casing of molybdenum, which disappears on the addition of nitric acid. The compound then appears under the microscope in the form of iron-grey rhombic prisms, which easily dissolve in hot nitric and hydrochloric acids. The first gives a dark brown solution. When heated to redness in the air, the compound becomes steel-blue.

Aluminium and Manganese.—Al_3 Mn. This compound is obtained by fusing together 10 grammes of anhydrous chloride of manganese, 30 grammes of chloride of potassium and sodium, and 15 grammes of aluminium. After the perfect extraction of the excess of aluminium by means of hydrochloric acid, this alloy forms a dark-grey crystalline powder, in which square prisms are recognised under the microscope. The specific gravity is 3·402. Cold concentrated nitric acid does not attack the compound, but in hot, as well as in hot hydrochloric acid, it is easily soluble. Dilute soda ley extracts all the aluminium.

Aluminium and Iron.—Al_2Fe. Obtained by fusing 10 grammes of aluminium with 5 grammes of chloride of iron and 20 grammes of chloride of potassium and sodium. The regulus is very crystalline. By careful digestion in very dilute hydrochloric acid the compound is left behind in the shape of fine six-sided prisms of an iron colour. As this compound is soluble in hydrochloric acid, and as soda ley extracts the aluminium, it was not possible to obtain it of a constant composition. The crystals whose analysis came nearest to the above formula had a corroded appearance under the microscope.

Aluminium and Nickel.—Al_3 Ni is formed when 8 grammes of aluminium are fused with 3 grammes of sublimed chloride of nickel and 20 grammes of chloride of potassium and sodium. By treatment with dilute hydrochloric acid, in which it is not soluble, the compound is obtained in large crystalline foliations of a tin-white colour which have the specific gravity 3·647. It is easily soluble in strong hydrochloric acid. When heated in hydrochloric acid gas, chloride of aluminium escapes, and nickel remains behind.

Aluminium and Titanium.—Michel obtained this compound in microscopic square tables. By heating in hydrochloric acid gas it is changed into the chlorides, the analysis of which led to the formula Al_2Ti.

The author remarks that it is very probable that aluminium may combine with single metals in several

proportions, according to the method of operating and the temperature.

II. ORGANIC CHEMISTRY.

Collic Acid and its Aldehyde.—Among the products of the oxidation of gelatine and albuminoid matters by the above method, the same chemist has discovered a new acid. (*Journ. für prakt. Chem.*, Bd. lxxx. s. 344.) It is separated in the following way:—The liquors obtained by distilling gelatine with sulphuric acid and the bichromates, are saturated with carbonate of soda, and distilled to separate the nitriles and aromatic oils. The residue is evaporated to a small volume over a water-bath, and then treated with dilute sulphuric acid to separate the solid acids which are collected on a filter. These acids are benzoic and the new acid. While on the filter these acids are treated with boiling water, which dissolves and carries away the benzoic, and melts the collic acid which solidifies upon the filter on cooling. A kilogramme of gelatine yielded 0·96 grm. of the new body. The melting point of collic acid is about 97° C. At a high temperature it sublimes. It dissolves easily in ether, and with difficulty in cold and hot water. It has an acid piquant taste. The composition appears to be expressed by the formula $C_{13} H_4 O_4$, which makes it an homologue of benzoic acid. The aldehyde of collic acid is also met with among the products of the oxidation of gelatine and albuminoid substances. It is thick oil, reddish after exposure to air, but colourless after rectification. It has an odour like oil of cinnamon. With ammonia it gives a white crystalline substance, probably analogous to hydrobenzamide. The author believes in the existence of a third solid aromatic acid among the same products, which may be toluic.

Products of the Oxidation of Tyrosine.—Froehde has also submitted tyrosine to the action of sulphuric acid and bichromate of potash (*Ibid.* p. 483). In this case a lively reaction takes place, carbonic acid is evolved, and there is a strong smell of hydrocyanic acid and hydruret of benzoyle. Benzoic, acetic, and formic acids are also found to be present. As the above bodies, with the exception of the hydruret of benzoyle and the benzoic acid derived from it, are the same as those furnished by the oxidation of glycocoll, the author supposes that, at the commencement, tyrosine splits up into hydruret of benzoyle and glycoll.

$$\underbrace{C_{18} H_{11} NO_6}_{\text{Tyrosine}} = \underbrace{C_{14} H_6 O_2}_{\text{Oil of Bitter Almonds}} + \underbrace{C_4 H_5 NO_4}_{\text{Glycocoll.}};$$

the other bodies being products of the oxidation of this last.

Action of Oxide of Copper on Proteic Compounds.—Vogel and Reischauer noticed (*Chem. Centralblatt*, Bd. v. s. 301) that, when the skin of the fingers, which had been in contact for some time with a strong solution of nitrate of copper, was moistened with soda, it became violet coloured. The same happens with feathers and the fibroine of silk. When silk is digested with caustic soda, and a small quantity of nitrate or sulphate of copper is added, the fibroine dissolves at the same time as the hydrate of copper. With an excess of copper this solution is blue, but with an excess of the fibroine it is violet, crimson, or even blood red.

MISCELLANEOUS.

Tin.—If there be any one substance more than another that has rendered England famous throughout the world, it is Tin. Camden, the historian, supposes that this country, from the abundance of tin which it contains, was called Britain. In the Syriac language *varatanac* signifies *land of tin*; whence is derived Britain. The mention of tin by Moses, in the 31st chapter of Numbers, 22nd verse, is a proof of its being known from the most remote antiquity. Long before the Christian era the trade in tin caused many a vessel to spread its sails in the Mediterranean Sea, and to cross the Bay of Biscay to fetch it from these shores. The alchemists of old considered tin to be a mixture of silver and lead, but modern chemistry proves it to be a distinct metal. About 10,000 tons of tin are extracted every year from the mines in Cornwall and Devon, nearly the whole of which is consumed in the manufacture of tin-plate (*fer-blanc*, or white iron, as the French term it), that is, sheet iron coated with tin; and it is this substance which constitutes our famous tin-ware, which finds a market from Naples to Japan, from New York to Eupatoria. Melted tin forms a sort of varnish for iron, and prevents that metal from rusting; when copper is coated with it verdigris cannot be produced. Tin and lead melted together produce what is called "Britannia metal:" of which teapots and similar domestic utensils are made. It is owing to a mordant of tin that the dyer produces the fine scarlet cloth so famous as the Royal and Military colour of this country. In many other ways we could show how very useful tin is; but it is enough for us to state that England is the tin-plate manufacturer for the whole world.—*Piesse's Laboratory of Chemical Wonders.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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J. D. P.—The address has been forwarded.

H. Parkes.—Many thanks for the information. We shall always be glad to receive communications from an old friend whom we well remember.

T. W. S.—The letter shall appear in our next.

Dr. F. C. Calvert.—Received with thanks, but too late for the present number.

Enquirer.—The current Volume is the only one which will consist of more than 26 Numbers.

Dyer, North Britain.—The reference quoted was intended for you. A few copies only of our First Volume remain on hand. The price is 8*s.* 6*d.*, or by post, 9*s.* 2*d.* We are obliged for the information.

Feather-Dyeing.—A work by a person named Lowe, has been published on this subject in London. The same process may be adopted for dyeing feathers as for silk dyeing, but the dressing is different. Some of Lowe's methods are not quite the best, for instance, in dyeing scarlet, he uses annatto and safflower, a better colour can be obtained by using annatto, tin, and then finish with cochineal.

Books Received.—"The First Step in Chemistry," by Robert Galloway, F.C.S. Third Edition. J. Churchill. "The Boys' Play-book of Science," by J. H. Pepper, F.C.S. Routledge, Warne, and Routledge. "The Play-book of Metals," by J. H. Pepper, F.C.S. Routledge, Warne, and Routledge.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Chlorine, Bromine, and Iodine, by FREDERICK FIELD.

IN the year 1857 I published a short paper in the *Quarterly Journal of the Chemical Society*, "On the Separation of Iodine, Bromine, and Chlorine, and the Comparative Degree of Affinity of these Elements for Silver; with some Analyses of their Combinations with that Metal occurring in Chili." The Paper was also read before the Royal Society, and an abstract published in the *Chemical Gazette* for August, 1857. Dr. Fresenius, in a note in the third edition of his work on "Quantitative Analysis," p. 393, says:—"The method recently recommended by F. Field (*Chemical Gazette*, 1857, No. 357) for the separation of chlorine, bromine, and iodine, rests on a false basis, as iodide of silver is sufficiently soluble in iodide of potassium solution, and bromide of silver in bromide of potassium solution to give rise to very considerable mistakes." As I have made many separations by the use of this method with considerable success, and other chemists, among whom may be mentioned Dr. Hofmann,[1] have also employed it, I feel it expedient to make some few remarks upon the assertion of Dr. Fresenius, and to endeavour to show that the process need not be condemned, even upon the authority of that eminent analyst.

Dr. Fresenius may be correct in saying that the separation of the three elements in question rests upon a false basis, as the precipitates are soluble in the iodide and bromide of potassium, but he probably has not studied the action of very weak solutions of these last-mentioned salts upon the silver compounds. In my paper in the *Quarterly Journal of the Chemical Society*, after giving many estimations, it is said:—"All the filtrates were severally tested for silver by passing a stream of hydrosulphuric acid through them for a considerable time. In one instance, the iodide of potassium added in rather great excess, after filtration from the precipitated iodide of silver, exhibited a very faint brown tinge. The others remained unaffected." It will be seen by reference to the estimations published in the memoir just quoted, that the results are not far from the truth. For instance, 10 grains of chloride of sodium were decomposed by nitrate of silver, and the precipitated chloride digested in bromide of potassium. Weight of precipitate obtained, 32·04 grains; calculated weight of bromide, 32·09.[2] 32·04 grains of bromide of silver contain 18·41 of silver; the substance in question gave 18·38. The same accuracy occurred in adding the chloride of silver to iodide of potassium. Chloride of silver, from a solution of the nitrate, and 10 grains of chloride of sodium, was digested in iodide of potassium. Precipitate obtained, 40·17 Ag^r = 18·46 Ag.; calculated weight, 40·13 = 18·44 Ag.

After many more experiments, this part of the paper concludes as follows:—"Although the results above stated are not very far from the truth, more experiments are necessary before this method can be admitted into quantitative analysis. The great fear, as already stated, is, that the solutions of the liquids in which the silver compounds are digested should be made too concentrated, in which case the latter are dissolved to some slight extent even in the cold. By preliminary experiments on the part of the analyst, and a knowledge of the quantities of the substance taken, great excess may of course be avoided." This paragraph will prove clearly enough, I hope, that I was alive to the danger of using large excess of the decomposing re-agents, and of having the solutions too concentrated. To those who have not read the method in question, it may be as well, perhaps, as briefly as possible, to explain it, in order to illustrate what is written in the concluding lines regarding a *knowledge of the quantities* of the substance taken. The liquid to be examined is divided into three equal portions. To the first is added slight excess of nitrate of silver, and the precipitate, after the requisite analytical precautions, is weighed. It is presumed that we have only chlorine, bromine, and iodine in solution, and the precipitate consists therefore entirely of these elements in combination with the metal. To the second is added nitrate of silver as before, the precipitate filtered off, washed, returned to the flask, and digested in a weak solution of bromide of potassium. A similar operation is performed with number three, the precipitate in this instance, however, being digested with a weak solution of iodide of potassium instead of the bromide. In the first flask the weight of the chloride, bromide, and iodide of silver is found; in the second that of bromide and iodide of silver; and in the third simply of iodide of silver. Bromide of potassium, having no action upon iodide of silver, has converted the chloride into the bromide, leaving the iodide untouched. Iodide of potassium, having the power to decompose both chloride and bromide, the whole is converted into the iodide. Now, as the weight of the first precipitate is known, it is easy to calculate more or less the quantity either of bromide or iodide of potassium requisite for its decomposition. It would be folly to add a solution containing 50 grains of either salt to a silver compound, the weight of which perhaps was 10 grains, as, even admitting that the whole 10 grains consisted of chloride, in which case the maximum amount of the decomposing agents would be required, from 12 to 14 grains of the bromide, and from 18 to 20 of the iodide would be amply sufficient; and this quantity, moreover, when dissolved in a large amount of water placed upon small portions of either bromide or

[1] See "Estimation of Bromine in a Mineral Water," by Dr. Hofmann, *Quarterly Journal of the Chemical Society*, 1860.

[2] 10 grains Na Cl = 6·06 Cl = 24·49 Ag Cl. This, digested in K Br (provided no silver were dissolved), should give the result above quoted.

iodide of silver has no solvent action. In order to prove these statements the following experiments were performed, which will be found to corroborate to the fullest extent the accurate results which were obtained by me in the earlier experiments upon the subject:—4·25 grains nitrate of silver (= 2·70 silver) were precipitated by a slight excess of chloride of sodium, and the washed precipitate digested in 8 ounces of water, containing 10 grains of bromide of potassium in solution.

After about three hours the silver salt was filtered off, and sulphuretted hydrogen passed through the filtrate. Not the slightest precipitate, or even turbidity was occasioned. A solution of nitrate of silver was made by dissolving 1 grain of the salt in 2,000 grains of water, and one drop added to a weak solution of sulphuretted hydrogen, when a colour was immediately produced. In order to prove that neither iodide nor bromide of potassium exercise any influence upon the precipitation of silver by hydrosulphuric acid, one drop of the same solution of the nitrate was added to the filtrate from the bromide of silver, to which solution of iodide of potassium had been previously introduced, after having passed the stream of sulphuretted hydrogen as before mentioned, when an instantaneous blackening occurred throughout the liquid. In order to correct the experiment, the bromide of silver was weighed with the usual precautions. It proved to be 4·67 grains; the calculated quantity should have been 4·69,—a result sufficiently approximative to show that the experiment was fully successful, all the chloride being converted into the bromide of silver, and no trace of metallic bromide dissolved by the slight excess of bromide of potassium.

2·97 grains nitrate of silver (= 1·89 silver) were treated in the same way, and digested in about 6 ounces of water, containing 6 grains bromide of potassium. After some hours the precipitate was filtered off, which, with the washings, measured nearly 12 ounces, and evaporated to a little more than half-an-ounce. Sulphuretted hydrogen failed to give any reaction even here, although passed through a solution so highly concentrated. The bromide of silver was not estimated in this instance.

1·27 nitrate of silver (= 0·806 silver) were similarly treated, and digested with 4 grains of bromide of potassium in rather more than 4 ounces of water. After evaporation the filtrate gave no coloration with sulphuretted hydrogen.

In order to see if a comparatively large excess of bromide of potassium exercised much solvent power upon the bromide of silver, 5 grains of the nitrate of that metal (= 3·17 silver) were converted into the chloride, as in the previous experiments, and digested in 8 ounces of water, containing 20 grains of bromide of potassium. As 5 grains of nitrate only equal 4·23 of chloride of silver, and less than 4 grains of bromide of potassium are capable of changing the chloride into the bromide, it will be observed that five times the requisite quantity was employed. Sulphuretted hydrogen was passed through the filtrate for about a quarter of an hour with no apparent effect; but on concentrating the liquid to about one-tenth of its original bulk, it assumed a brownish tint, doubtless owing to a minute trace of silver, far less, however, than the $\frac{1}{1000}$ of a grain, and quite inappreciable by the balance. The bromide of silver weighed 5·48, the calculated quantity being 5·519.

Deeming further experiments upon the action of bromide of potassium upon chloride of silver, when the former is in solution in a large quantity of water, unnecessary, I proceeded with some experiments upon the action of iodide of potassium on the metallic chloride.

5 grains nitrate of silver (= 3·17 silver) were precipitated by chloride of sodium, and the resulting chloride of silver suspended in 6 ounces of water, containing 10·54 grains of iodide of potassium. The action was allowed to continue for more than six hours, after which the precipitate was separated by filtration and a current of sulphuretted hydrogen passed through the filtrate. No effect was produced, nor could any change be discovered after evaporation over a water-bath until the liquid only measured half-an-ounce. The iodide of silver weighed 6·860, calculated quantity required being 6·897.

The same quantity of nitrate of silver, after precipitation by slight excess of solution of chloride of sodium, was digested in 10 ounces of water, containing 20 grains of iodide of potassium. The filtrate gave no trace of silver on the addition of hydrosulphuric acid, but, after concentration, a brownish shade was apparent. The iodide of silver in this case weighed 6·85, approximating very closely to the last result.

As a concluding experiment, 5 grains of nitrate of silver were precipitated by a mixture of solutions of chloride and bromide of potassium, and the precipitate digested in iodide of potassium (12 grains, 48 ounces of water). In ten hours the filtrate was examined, and showed no signs of silver, even after evaporation to a very small bulk. The iodide of silver weighed 6·870 grains.

From these experiments, it appears to me that this method of separating chlorine, bromine, and iodine is unexceptionable. That quicker and quite as accurate modes of analysis may be employed I do not doubt, although few operations in chemistry are simpler than those discussed in this paper, as any one with the ordinary knowledge of laboratory manipulation may prove for his own satisfaction. I am almost inclined to be gratified that the correctness of the process was called in question by the analyst from whose researches I, in common it may be presumed with most chemists, have derived very great benefit and instruction, inasmuch as it has led me to test pretty severely, the advantage of a method I proposed, with a degree of caution and anxiety, in the year 1857. Other experiments with regard to the separation of chlorine, iodine, and bromine must be reserved for a future Number.

[When I sent my paper "Upon the Various Degrees of Affinity of Chlorine, Bromine, and Iodine for Silver" to the Chemical Society, I was unaware that Mr. F. M. Lyte had already experimented upon the same subject and arrived at the same results. Mr. Lyte, it appears, had a patent granted him as far back as 1853 for improvements in obtaining iodide of potassium, which consisted chiefly in adding chloride of silver to solutions rich in alkaline iodides until all the chlorine is in solution and the silver entirely converted into the iodide. By fusing this compound with carbonate of potassa, metallic silver and iodide of potassium are obtained.—F. F.]

On Water Viewed as Hydric Acid, and on the Metallic Hydrates, by Arthur H. Church, *B.A., F.C.S.*

A study of their functions suggests a sense in which not only water, but even ammonia, may be regarded as acids. In the case of HCl, the first great primary type, the simplicity of its formula—the single atom of H combined with the single atom of Cl—excludes varied sub-

stitutions; and this holds good even when several molecules of HCl are conjoined to form a new compound type. But we may regard water, $H_2\Theta$, placed as it is in the theory of types midway between hydrochloric acid, HCl, and ammonia, H_3N, in more than one mode. Generally, we may regard compounds formed on the water-type as neutral, but sometimes as basic and sometimes as acid. Occasionally, indeed, the same substance may be viewed in two of these aspects, or even in all three, according to the nature of its metamorphoses, and the conditions under which they are effected. But at present we propose, for the sake of clearness and precision, to dismiss from consideration the almost numberless organic substances which we may justly regard as formed on the water type, and to limit our attention to the metallic hydrates. Not that such organic bodies fail to corroborate the manner of viewing water as an acid; on the contrary, they, in many instances, most strongly confirm such an opinion. Though outside our present scope, the citation of a few illustrative examples of such confirmations may serve to warrant the correctness of our statements. We have but to refer to the simpler organic acids and alcohols. Here, if one atom of hydrogen of water be replaced by a weakly-basic radical, the acid power of the oxygen has not been wholly satisfied, and the compound, acid or alcohol, is ready to exchange the remaining atom of hydrogen for another more basic atom; and sometimes may be made, though with difficulty, as when anhydrides are formed, to assume an atom of an equally electro-negative, or even of a less basic and more electro-negative radical.

We have said above that under certain conditions ammonia itself assumes the character of an acid. This is the case, if in fact, we are to apply the term acids to all those combinations of elementary or compound radicals which contain hydrogen replaceable by a metal. The following parallel reactions will serve to make this clear. When potassium acts upon HCl, or $H_2\Theta$, or H_3N, perfectly analogous results follow, as may be seen in the annexed table of equations:—

$$\left.\begin{array}{lll} KK + 2H\,Cl = HH + 2KCl & \text{chloride} \\ KK + 2H_2\Theta = HH + 2KH\Theta & \text{hydrate} \\ KK + 2H_3N = HH + 2KH_2N & \text{amide} \end{array}\right\} \text{of potassium.}$$

Thus, the functional position and relation of water, and numerous facts concerning the metallic hydrates, will warrant us in viewing this liquid for once as hydric acid—the hydrate of hydrogen. Some chemists may here affirm, what has been often affirmed before, that it is useless and unwarrantable to assume the existence of a compound acid radical in water. They may object to any other mode of viewing water except that in which it is regarded as the normal hydrogen compound of the diatomic acid radical oxygen. But, surely, we are justified in regarding any substance in all ways which can possibly tend to throw light upon its chemical relations. A certain group, $H\Theta$, is found, like Cl, to unite with other groups or single elements without losing its integrity under new conditions; like Cl, two or more of these groups, $H\Theta$, may thus attach themselves. Now, if that view of water which makes it a monobasic acid, without violence to any series of facts, but rather in strict accordance with several such series, enables us to arrange the salts of this acid, the hydrates, in complete parallelism with the salts of admitted monobasic acids, such a view is seen to be both allowable and instructive. If the existence of radicals of any kind be admitted, then we may claim that rank for the group $H\Theta$. And if we consider cyanogen, ΘN, to be a radical capable of travelling from one body into another as a whole, then the group, $H\Theta$, to which we may provisionally assign the name Hydrine, undoubtedly offers the same characteristic features. Hydrine, like cyanogen, and all other radicals, cannot exist when liberated from the bodies believed to contain it in that simple form which it then possessed, but combines with itself to constitute the isolated molecule. The molecule is peroxide of hydrogen, $H_2\Theta_2$, the hydrate of hydrine, exactly corresponding to free cyanogen, $\Theta N\Theta N$, the cyanide of cyanogen. The following formulæ point out the parallelism of the two series:—

$HH\Theta$	$H\Theta H\Theta$	$H\Theta N$	$\Theta N\Theta N$
Hydrate of hydrogen.	Hydrate of hydrine.	Cyanide of hydrogen.	Cyanide of cyanogen.

We shall be able to compare the relations of the hydrates to other salts when we have noted the formulæ of the various classes of these bodies.

Different metals act upon hydric acid, as on other acids, in different ways. By means of these differences, a somewhat arbitrary method of classifying the metallic elements has been invented. When hydric acid acts upon the most basic or electro-positive metals, those of the first and second groups, hydrates—known as the alkalies and caustic earths—are produced. These salts partake strongly of the basic character of their metallic constituent, and show an energetic alkaline reaction; their general formula is $M'H\Theta$. The hydrates of the earthy metals proper exhibit but feebly basic characters. Among their general formulæ is $M_2'''\div''(H\Theta)_3$.[1] The hydrates of the remaining metals in some cases exhibit decidedly acid properties; their formulæ are very varied, such expressions being found as $M_2'\div''H\Theta$, $M'''(H\Theta)_3$, and $M''(H\Theta)_2$. A ferric hydrate of the formula $(Fe_2)_2(H\Theta)_3$ is also known. We may now make the comparison between corresponding chlorides and hydrates:—

	Cuprous.	Potassic.	Aluminic.	Stannic.[2]	Bismuthic.
Chloride:—	$Cu_2'\div''Cl$	$K'Cl$	$Al_2'''\div''Cl_3$	$Sn''Cl_2$	$Bi'''Cl_3$
Hydrate:—	$Cu_2'\div''H\Theta$	$K'H\Theta$	$Al_2'''\div''(H\Theta)_3$	$Sn''(H\Theta)_2$	$Bi'''(H\Theta)_3$

The ratios of metallic to acid constituent in these five classes of salts is respectively 12:6, 6:6, 4:6, 3:6, and 2:6. This is, of course, owing to the different atomic values of the variable or metallic elements in these compounds.

The hydrates generally (the alkalies and alkaline earths being conspicuous exceptions) are unstable salts, splitting with ease into water and metallic oxides:—

$$\begin{array}{ll} 2M_2H\Theta & = M_4\Theta + H_2\Theta \\ 2MH\Theta & = M_2\Theta + H_2\Theta \\ 2M_2(H\Theta)_3 & = M_4\Theta_3 + 3H_2\Theta \\ 2M(H\Theta)_2 & = M_2\Theta_2 + 2H_2\Theta \\ 2M(H\Theta)_3 & = M_2\Theta_3 + 3H_2\Theta \end{array}$$

The author does not contend for any originality in the above remarks; he has merely arranged and commented on a few of the facts which point to the acid function of water. The unitary notation has enabled him to exhibit with some precision the symmetries and relations of the formulæ adduced.

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[1] $M'''\div'' = H_{1.5}$ in atomic value, or $\frac{3}{2}H$.

[2] Stannic hydrate, when dried below 55° C., has the formula $Sn_2H_2\Theta_3 + H_2\Theta = 2SnH_2\Theta_2$.

On the Quantitative Separation of Lime and Magnesia from the Sesquioxide of Iron, by Dr. F. Crace Calvert, *F.R.S.*

Having noticed in your excellent Journal of December 1st the abstract of a paper published recently by M. H. Rose on the above subject, I am induced to forward you the following facts, which I hope will prove useful to analysts:—

Having occasion, two or three years since, to analyse some artificially-prepared silicates of lime and oxide of iron, I followed, with slight modifications, the well-known method as described in our standard works of analyses, viz.:—I dissolved the silicates in aqua regia, evaporated the whole nearly to dryness, and then mixed it with three times its weight of a mixture of alkaline carbonates, and melted the whole. The fused mass was then treated with water, which dissolved the alkaline silicates and left the lime and sesquioxide of iron as an insoluble residue. This in its turn was dissolved in an excess of strong hydrochloric acid, so that chloride of ammonium might be formed—which would keep the magnesia in solution in case any was present—on the addition of ammonia to the chlorides, properly diluted, thus separating the hydrated sesquioxide of iron from the lime. But, to my astonishment, I could not obtain more than half the amount of lime which must have existed in the silicate analysed, although the necessary precautions had been taken to use ammonia entirely free from carbonate, washing thoroughly the sesquioxide of iron with boiled distilled water, and determining the lime by throwing it down as an oxalate and then converting it into a sulphate. This led me to make a series of researches which proved that the sesquioxide of iron as above procured contained a large amount of lime.

To avoid this source of error in analyses, which must frequently occur in consequence of the bases being so common, I believe that the following method of separating lime and magnesia from the peroxide of iron will be found to give satisfactory and accurate results. It consists in dissolving these oxides in an excess of hydrochloric acid, diluting the liquor and neutralising it as far as practicable with ammonia before precipitating the sesquioxide of iron by succinate of ammonia, the succinate of sesquioxide of iron thus formed being gathered on a filter, washed and calcined, adding a little nitric acid to insure the whole of the mass being in a peroxidised state, the lime and magnesia being determined by the usual well-known methods.

I shall conclude by observing that the larger the proportion of oxide of iron as compared with that of lime, the greater is the proportion of lime carried down by the hydrate of the sesquioxide of iron.

TECHNICAL CHEMISTRY.

On the Preparation of Fulminate of Mercury with Lignone, by M. Stahlschmidt.

It has already been shown that it is unfit to employ amylic alcohol in preparing a compound analogous to fulminate of mercury, obtained with ordinary alcohol. M. Stahlschmidt has come to the conclusion that it is the same with pure wood-spirit,—a result, moreover, according with the observations published by MM. Dumas and Peligot.

Having, nevertheless, obtained with commercial wood-spirit an explosive substance, but not succeeding in preparing it at will, he investigated the cause of this anomaly, and discovered that success was essentially owing to the presence of a compound known under the name of lignone,[1] which is always found in proportions more or less considerable in the various kinds of wood-spirit used in commerce.

For the preparation of fulminate of mercury with this agent, take,—

Lignone	6 parts
Water	4 „

To these add 4 parts of a solution of nitrate of protoxide of mercury, formed of 8 parts water, to 1 of salt; lastly, add gradually 5 parts of nitric acid, and heat until bubbles begin to be disengaged; from this stage the reaction goes on spontaneously, and even becomes tumultuous; meanwhile the fulminate deposits itself. If the reaction becomes too violent it can be allayed by the addition of a little water, or, better still, by plunging the flask into cold water. It is important to maintain the above-mentioned proportions; for, with excess of nitrate of mercury, it is very easy to get only a caseous deposit of oxalate of protoxide of mercury, not unlike that prepared with pure wood-spirit.

The fulminate thus obtained appears identical with that of Howard: it presents itself in crystalline plates, which when dissolved in ammonia, separate into little granular crystals. When heated with potash it abandons oxide of mercury, and the supernatant liquid, and deposits blue detonating flakes; by the addition of nitric acid to the remaining portion of mother liquor a new deposit is obtained, equally susceptible of detonation after drying. When boiled with water and copper filings the fulminate prepared from lignone yields a green liquor, which, when cold, deposits green flakes of highly-detonating fulminate of copper. If moderately heated with aqua regia, the new fulminate of mercury gives rise to a disengagement of hydrocyanic acid, carbonic acid, and a gas very irritating to the eyes.—*Annal. der Physik und Chem.*, bd. cx. p. 547.

On the Agricultural Employment of Nodules of Phosphate of Lime, by M. Bobligue.

I am of opinion that the inefficacy of native calcareous phosphates can, in numerous instances, be traced to two principal causes:—

1. To the great cohesion of this substance, which renders assimilation very difficult when it is determined only by natural agents. An attempt has been made to remedy this disadvantage by treating the nodules with powerful mineral acids, but this is a costly method, and might perhaps prove injurious to those lands which do not contain a sufficient quantity of bases in a condition to saturate the excess of acid employed to effect the solution of the calcareous phosphate.

2. To the absence of soluble silica. Now, silica is as indispensable to cereals as phosphoric acid; it forms their skeleton, and to its absence is justly attributed the contingency called "versement." If the soil contains an insufficient quantity of assimilable silica, the stalk does not acquire the properties necessary for a good harvest, and the phosphates added to the soil, under these circumstances, are useless. These considerations have guided me in devising some means to ensure the useful employment of the nodules.

[1] Called also Xylite by MM. Weidmann and Schweizer, who extract acetic acid and wood-spirit from it by distillation over caustic potash; the molecule ethyle is then represented in the lignone which Gerhardt considers as a mixture of acetone and acetic ether.

Pulverised nodules are mixed with 50 per cent. of their weight of sea salt. This mixture is exposed, in a furnace or cylinder, in a current of steam, to a temperature a little below redness.

If, as is sometimes the case, the nodules do not contain a sufficiency of silica, the deficiency must be made up previous to the operation. The re-action of silica on chloride of sodium in contact with the vapour of water is well known, resulting in the formation of silicate of soda and hydrochloric acid. In this special case the latter acts on the phosphate of lime, from which it takes two equivalents of lime, and gives rise to chloride of calcium and biphosphate of lime. However, all the phosphoric acid does not combine with the lime; it sometimes forms a considerable quantity of phosphate of soda. It is thought that this latter product is chiefly owing to the decomposition of phosphate of iron. All this metal, in fact, is found in the state of sesquioxide, crystallised in spangles, as has been for a long time established in calcining sulphate of iron with chloride of sodium.

The same process thus furnishes both silicates and phosphates in the dry state without excess of acid, which readily yield to plants not only silica and phosphoric acid, but also a considerable quantity of alkali.—*Comptes-Rendus.*

PHARMACY, TOXICOLOGY, &c.

Remarks on Bœttger's New Test for Sugar in Urine, by J. ATTFIELD, *Demonstrator of Chemistry at St. Bartholomew's Hospital.*

IN examining urine for sugar by Trommer's, or the copper test, an exact experimenter first assures himself that uric acid is not present in abnormal quantity, knowing that the latter substance reduces alkaline solutions of copper in much the same manner as sugar. To obviate the inconvenience of performing two operations, Bœttger, some three years ago (*Journal de Pharmacie et de Chimie*, 1857), proposed the substitution of basic nitrate of bismuth for oxide of copper, the bismuth salt not being reducible by uric acid.

A few grains of the ordinary trisnitrate of bismuth of pharmacy are added to two or three drachms of urine in a test-tube; an equal bulk of a solution composed of one part of crystallised carbonate of soda in three parts of water is then poured in, and the whole gently heated to boiling. If sugar be present the mixture changes to a deep-brown or black colour, due to the reduction of the oxide of bismuth.

This bismuth test is certainly very delicate; far more so than Trommer's. If water to which the merest trace of grape sugar has been added be treated in the manner described, ebullition being continued for three or four minutes, and the solution set aside for half-an-hour, abundant evidence of the presence of the sugar will be obtained; Trommer's test, in this case, failing to give a re-action. Sugar does not reduce the bismuth salt in the presence of sesquicarbonate or bicarbonate of soda. Caustic soda, or caustic potash, however, seem to answer as well as carbonate of soda; but the latter is probably the best, or Bœttger would not have selected it. The black compound produced appears to be the body that has been described by some chemists as suboxide of bismuth, but which is now generally considered to be only a mixture of metallic bismuth and ordinary teroxide. It is in an exceedingly fine state of division, but its particles can be easily seen with a magnifying power of 50 diameters; it wholly precipitates to the bottom of the test-tube after six or seven days' repose, and some also is carried down at the time of making the experiment by the excess of the bismuth salt used.

While, however, Bœttger's test gets rid of one inconvenience, it introduces another. Albumen must first be proved to be absent, for that body also causes blackening of the oxide of bismuth; hence the method has not the value that at the first glance it would appear to have. The action of albumen is, it is true, far less energetic and complete than that of sugar; still, blackening does occur to a greater extent than would be accounted for by the influence of the sulphur in the albumen, and to an extent, moreover, that would justify an experimenter in concluding sugar to be present if he did not know that a similar re-action might be otherwise produced.

The very delicacy of this test seems to me to be another objection to its application to urine as a clinical aid in the diagnosis of diabetes mellitus. Nearly all specimens of urine colour, more or less, the basic nitrate of bismuth. Professor Brücke, relying upon its sensitiveness, as well as upon modifications of the other tests, has gone so far as to assert that sugar is a normal constituent of urine. When, however, we remember, how frequently urine contains small quantities of albumen, and, as suggested by Lehmann, that taurylic acid, hypoxanthine, and one or two other constituents of urine, are weak reducing agents, ever ready to absorb oxygen from oxide of copper, oxide of bismuth, or anything else that holds that element but loosely, we hesitate before admitting Professor Brücke's assertion, and require further evidence on the matter.

Basic nitrate of bismuth is, then, an exceedingly sensitive test for the presence of sugar in alkaline solutions generally; but is not applicable to the detection of sugar in urine, inasmuch as other bodies in that fluid produce similar reactions. Uric acid does not interfere with Trommer's test to the extent that albumen interferes with Bœttger's. Indeed, for medical purposes, the copper test fulfils all desirable conditions; for only when sugar continues to exist in urine in readily appreciable quantities can a patient be declared to be suffering from diabetes mellitus.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On Food, by EDWIN LANKESTER, *M.D., F.R.S.*

LECTURE IV. *On Oil, Butter, and Fat.*

I will continue to-day to draw your attention to that class of foods which we know by the name of Heat-giving, and to the group of which I am now speaking. This group may very well be divided into,—first, those which contain starch and sugar; and, secondly, those which contain oil.

There is a great difference in the chemical composition of oils and fats, as compared with starch and sugar. Taking, then, the composition of starch and sugar as $C_{10}H_{10}O_{10}$, which would express, generally, the composition of starch and sugar; or, taking the real weights, $C_{72}H_{10}$ and O_{80}, you see there would be about half the quantity of carbon by weight in starch and sugar.

Now, if we take oil, we shall find the difference is very great. Taking all these substances which are indicated by the term Oil, such as fats, butter, lard, suet, grease, and tallows, their composition will be this,—$C_{56}H_{10}O$. Now, I call your attention to this for this purpose,—you

see in the starch and the sugar the hydrogen and the oxygen are just in the proportions in which those two elements form water; but, if we take the fats and oils, you will see there is a large quantity of the hydrogen to spare and very little oxygen; and this oxygen and hydrogen are not in the proportion to form water. So that you see in an oil or fat, instead of having only about half its bulk, as you have in starch and sugar, for the purpose of combustion, you have actually the whole mass for combustion; 66 parts of carbon, 10 of hydrogen, and 1 of oxygen, in 77 parts of oily matter; and this is a practical point, for where you are substituting fat for starch or sugar, there you ought to substitute a very much less quantity of this fatty matter than starch or sugar, for the proportionate value of fatty matter, as compared with starch and sugar, is as 2½ times to 1, so that you should take as a substitute for butter 2½ times the quantity of starch or sugar.

Now, this oily matter which we have to speak of to-day, is used not only as an article of diet, but it is extensively employed in the arts. I would remind you that we use it for combustion. Until the introduction of gas it was the only substance that could be generally used for illumination; we use it also for diminishing friction. The power which oil has for diminishing friction is very great, and this physical property is of the greatest consequence to us as a manufacturing nation. We send to all parts of the world for oil to diminish friction in machinery, which would, in fact, take fire, if it were not for this grease.

I have alluded to the fact that this oily matter is used for the manufacture of soap. Let me draw your attention, then, to the nature of the oleaginous matter first. I have said that all these matters have this general formula:—77 lbs. of any one of them would contain 66 lbs. of charcoal, 10 lbs. of hydrogen, and 1 lb. of oxygen. Now, these substances, although composed simply of carbon and hydrogen, do not present themselves to us in so simple a manner; and, though we know a good deal of the chemistry of those oils and fats, still there is, undoubtedly, a good deal to learn. If we take olive oil, and put it out into the winter's cold, you will find that it divides into two parts,—one, stearine, sinks to the bottom, and the other, oleine, floats to the top. Now, fats contain these two substances, the one solid, and the other liquid; and we can separate them into the stearine and the oleine; and sometimes we have another substance mixed with them. Thus, if you were to take goose-fat, instead of oleine or stearine you would get margarine: it differs so little that we need not speak of it as a separate substance, for it only contains a little larger quantity of oxygen, so we may leave it out of our consideration. But it is a very curious fact, that the wild horses of America contain larger quantities of margarine than the horses of this country,—and that shows you how one thing may be converted into another.

Now oleine is liquid at all temperatures. Castor-oil never throws down any deposit of this sort at all, and that is composed entirely of oleine. Then there is the Butter-tree, which gives an oil which is nearly all stearine. So with palm-oil from Africa, which is also obtained from the Island of Ceylon in large quantities from the plantations grown and cultivated there by Price's Patent Candle Company of London. Thus you see stearine and oleine have different relations to heat.

There is also another property which oils possess, and that is that they are insoluble in water; and this insolubility in water is one of their most remarkable characteristics. They are sometimes also called "fixed oils;" and this arises from the property which they possess of not being easily evaporated.

Let me now pass from the physical to the chemical qualities of oils and fats. I would only just say that they are principally composed of carbon and hydrogen, and these have inflammable properties. In fact, everything from which we obtain a light is composed of carbon and hydrogen. We may burn anything, and cause it to be incandescent from carbon alone; but where we have a flame we must have hydrogen. We know by the flame, in the case of burning alcohol, that we have carbon and hydrogen, and we know by the flame of the candle that we have carbon and hydrogen.

So much, then, for the composition of the fatty matters: you find that they are composed principally of carbon and hydrogen. We cannot burn sugar or starch in this way because the quantity of oxygen combined in the sugar and the starch takes away this hydrogen, and leaves only the carbon to burn, and we have to add a considerable quantity of heat in order to make this burn; and, when these substances get into the system, the water has to be withdrawn before they will produce heat. Another very curious point is that these things, oleine and stearine, are not simple chemical compounds of carbon, hydrogen, and oxygen, but they are actually put together in the form of an acid united with a base. Let me illustrate what I mean by taking a little piece of chalk, which is a compound of an acid with a base—the acid is carbonic acid, and the base is lime. I pour a little water on it, and afterwards sulphuric acid; and now, by the agency of the sulphuric acid, I expel the carbonic acid. You see here it is coming off very rapidly. Now, stearine and oleine are just as much compounds of an acid and a base as carbonate of lime. In the former we have a quantity of stearic acid with a base which is called oxide of lipyle, popularly known by the name of glycerine. Carbonate of lime is carbonic acid gas combined with oxide of calcium, and stearine is stearic acid combined with glycerine or oxide of lipyle, and this oxide of lipyle unites with the stearic acid just as the oxide of calcium unites with the carbonic acid.

In the human system these are not taken up as globules of oil or fat, for nothing that will not dissolve in water will pass through the system, and it is very interesting to find these chemical reactions going on. We are indebted to the art of soap-making for a knowledge of some curious properties of oils. I will take this olive-oil, put it into a bottle, and add some potash to it, and you see I have a soapy-looking mixture; instead of resisting the action of water, it is now soluble in it; and if I separated the glycerine, I should have this soap. Thus it is the property of the alkalies to form soluble salts with stearic or oleic acids. And when we add potash or soda to the oil, we supplant the glycerine by the alkali; and this glycerine used to be the refuse of the soap-boiler,—he threw it away, not knowing what to do with it; this glycerine is the natural base of the fatty matter contained in the oleine or in the stearine. This glycerine has been recently rescued from the condition of the refuse of the soap-boiler, and is now an important article of commerce. It is now separated, not only from the soap-maker's refuse, but also largely by the candle-maker. These candles are made of stearic acid, from which the glycerine has been got out. Why does the candle-maker take care to get rid of the glycerine? Because he has found out that the glycerine is that part of the fat which does not burn so well as the acid part, and now his great object is to get only stearic or oleic acids into his candles; and those who burn candles know very well that inferior moulds and dips are not for a moment to be compared with the better kinds, and this arises from the fact that glycerine contains a larger quantity of oxygen than the stearic or oleic acids. So that it is a great object to get rid of this glycerine from the fatty matters of which candles are made. This is now done by a very different process by Price's firm: this Company now separate the glycerine from the fatty acids by the agency of steam. The stearic acid falls, and the glycerine rises above, under the influence of steam; and that is the way the palm-oil is treated in all those establishments for the purpose of separating one from the other. Now, this glycerine has become an article of commerce. What is it

fit for? We have some fish in this Museum which have been kept for many years in glycerine. In fact, many of the things here are preserved in glycerine, showing that it has the power of preserving articles from decay. It has also a happy action on the surface of the skin, diminishing the amount of action going on by the effect of the atmosphere. It may sometimes be tried with success in the case of skin-disease; and where there is anything like exposure of flesh, glycerine must be useful: thus it is applied to chapped hands. It is also used internally. It is called glycerine in consequence of its having a sweet taste like glucose. It has been recommended in cases where cod-liver-oil has been taken, and it is more agreeable to take than the latter. Medical men are now using it, I believe, very extensively.

Soaps that are formed with potash or with soda are all soluble in water, but there are certain compounds of stearic and oleic acids, which are not soluble. So that we have insoluble soaps and soluble soaps. I have said, then, that the oils are converted into soluble soaps or salts by the agency of the alkalies, potash and soda. We have, then, three sorts of soaps,—there is the hard soap, which is formed by soda and a fatty acid, and there is the soft soap of the shops, which is formed by potash and a fatty acid. These two, you know, I can dissolve in water and form a lather with them, and another valuable quality which these soaps possess is the property of decomposing oil—of dissolving it. They not only are soluble themselves, but when they are rubbed on to a dirty hand—the hand having held the dirt by means of the fatty matter on the skin—these soaps dissolve the latter; and thus it is with linen and all substances. The soluble soap has the power of dissolving a further quantity of oil. But I have said there are some insoluble soaps. If this stearic acid were to combine with lime instead of potash, then you would get an insoluble soap which would not dissolve in water, and which would be anything but detergent. You know when you go to a district containing large quantities of carbonate of lime that, when you wash, a substance rises in the water and sticks to the skin, and you think it better to have no soap at all. The fact is that all this time you are forming an insoluble lime soap, and the lime takes the place of the soda. The best way in such a case is to set boldly to work about it and brush away until the lime is saturated, and then you may work with the soda soap.

Unless oils meet in the stomach with potash or soda they cannot become soluble. If they meet with other salts they are insoluble, and it is only as they meet with potash or soda that they can pass into the system and be taken up into the blood. Now this is very important, for if we insist on omitting these soda and potash salts from our food, there is nothing which can take their place. There is, however, a provision made which I shall speak of by-and-by for giving alkalies for the stomach.

Now I pass on to the action of the oily and fatty matters on the system. I have classified them with the starch and sugar, because, as I said before, they are maintainers of animal heat, and there can be no doubt that they do maintain animal heat, and that it is no mere theoretical statement, for it is a well-known fact that, when men are exposed to cold, they consume a large quantity of fatty matters. Sir John Franklin and all Arctic travellers have recorded their expressions of surprise at the quantity of coarse fat that those people who live in the Arctic regions will take. In his first voyage he gave to an Esquimaux boy some tallow candles to see how many he would eat, and it was not until he had eaten fourteen pounds that Sir John became frightened for his store, and gave the boy a large lump of fat pork to get out of the bargain. Even the sailors who go out in these Arctic expeditions use a large quantity of fat, and the pemmican which they use contains as much as eighty per cent. of fat. You will see with regard to our meat it does not contain more than fifty, and our cooked meat not more than fifteen per cent. of fat.

Generally the inhabitants of northern climates eat a larger quantity of fatty food than those of southern climes. In the North of Russia they get so in the habit of taking coarse fat that when they come South, they cannot do without it, and there were instances of the desire for this food in the case of the Russian troops lying at Portsmouth after the battle of Waterloo. The people of the town were surprised to find the oil lamps of the town went out very soon, and this could not be explained, until it was found that the Russian soldiers were in the habit of stealing out in the evening, climbing up the lamp-posts, and drinking up the oil. So that the habit of taking this fatty matter in cold climates seems to indicate that it is a more powerful heat-former than starch and sugar.

(To be continued.)

CHEMICAL SOCIETY,

Thursday, December 6, 1860.

Colonel P. Yorke, *F.R.S., Vice-President, in the Chair.*

Mr. James Barrett was elected a Fellow.

Mr. S. D. Hayes read a Paper "*On a New Lead Salt, corresponding to Cobalt Yellow.*" Heretofore cobalt yellow has been best obtained by passing a current of deutoxide of nitrogen through the mixed hydrated oxides of potassium and cobalt. The author improved upon this process by substituting peroxide of nitrogen, which is completely absorbed, for the deutoxide which is retained very imperfectly. On treating a solution of nitrate of lead with excess of potash, and subjecting the liquid to a current of peroxide of nitrogen, the gas was readily absorbed, with formation of a yellow coloured liquid, which by evaporation yielded yellow prismatic crystals. The compositions of cobalt yellow and lead yellow are expressed by the respective formulæ KO. CoO, $(NO_4)_2$ and KO. Pb O, $(NO_4)_2$ HO.

Dr. Hofmann, F.R.S. made a communication "*On the Production of Mixed Amines, Phosphines, and Arsines.*" When bromide of ethylene acts upon triethylphosphine, two principal products are formed, namely, the bibromide of ethylene-triethyl-diphosphonium, $(C_2H_4)''$ 6 $C_2H_5P_2$ Br_2, and the bromide of bromethyl-triethyl-phosphonium, (C_2H_4Br) 3 C_2H_5 PBr. By the further action of triethylphosphine the last-mentioned compound is converted into the first; and if ammonia, triethylamine, triethylarsine, or other body of similar construction, be substituted for the triethylphosphine, mixed phosphine amine, or mixed phosphine arsine compounds are produced.

NOTICES OF BOOKS, PATENTS, &c.

The First Lines of Science Simplified, and the Structure of Molecules Attempted. By John G. Macvicar, *D.D.* Edinburgh: Sutherland and Knox, 60, South Bridge. 1860.

For several years we have, at intervals, in various libraries and laboratories, come in contact with a pamphlet by Dr. Macvicar, of Moffat, in Dumfriesshire, called "Elements of the Economy of Nature. A Fragment." No one who has once seen it, even for an instant, will forget it, owing to the vast number of mysterious-looking, and—in fairness it must be admitted—exquisitely-formed diagrams, which abound in its pages. The excessively pretentious character of the title caused us, and doubtless many others, to read it; but, as might have been expected,

we found it to consist almost entirely of a mass of violent hypotheses and unwarranted conclusions. Somewhat to our surprise, we have recently encountered the pamphlet again, but disguised under the title given at the head of this notice. We find on looking at the book more closely, that it is formed by binding together the unsold copies of the old pamphlet, and an introduction of eighty pages. The new introduction being for the purpose of converting an unsaleable pamphlet into a new work with a new title. That what we have said is correct may be seen by the paper, the work itself being yellow from the effect of time, while the Introduction is on brilliantly new and white paper. We submit that the author's preface "To the Reader" does not put this process of book-manufacturing in its proper light, and we consider such a process as by no means legitimate. We recognise the old pamphlet from peculiarities which never could be forgotten. We shall never forget reading Dr. Macvicar's views as to "abyssal species." The chapter on Phosphorus and Silicon is infinitely amusing: the genesis of phosphorus from hydrogen "in the abyss" is argued in a manner that makes us doubtful whether to laugh at its folly or weep at seeing an active brain so waste itself. We are informed that, "Not in the abyss only, but as a mineral are we to expect this species." Again, "Ph may, therefore, be also a meteoric species, as well as a mineral and an organic species. Moreover, BoOoB (the boracic principle, undecomposably united with O, see Fig. N, p. 37), if simply effloresced, gives it."

One would think when Wieland wrote the following, he must have had prevision of Dr. Macvicar:—

"The situation of the most enchanted enthusiast is preferable to that of a philosopher, who, from continual apprehension of being mistaken, at length dares neither affirm or deny anything."

Dr. Macvicar has, for many years past, brought before the public, under various forms, his ideas of the structural symmetry of chemical molecules. We may, at starting, say at once, that, however opposed most of his views are to those of philosophers generally, not to say to those of most persons of common sense, they (the Doctor's ideas) are never rudely thrust forward,—they are never accompanied by abuse, direct or indirect, of those who do not agree with him; and we are told that all who know him regard him as a faithful priest, and a Christian gentleman. It is therefore, a really painful task to criticise his work, because we conscientiously believe nine-tenths of it to be arrant nonsense. There are, however, passages in it, showing the author to be a most thoughtful man, but pre-occupied by one all-pervading idea, to which everything else is made subservient. This idea is, that all substances are made up of atoms, arranged according to certain laws of symmetry, and possessing poles, equators, pelvic and thoracic regions, and liable to change, or prone to rest, according to the completeness with which the poles, equators, &c., are symmetrically covered. The Doctor is immensely addicted to applying the technical expressions of the various sciences to his own purposes, and in a manner so startling as to make one's hair stand on end. As, for example, when we find that cellulose is subject to hypertrophy, as at paragraph 177, which is headed "*Hypertrophy of Cellulose.*"

Dr. Macvicar is fond of law-giving; he enunciates, probably amongst others we have forgotten, Laws of Assimilation, of Least action, of Being, of Efflorescence,—but, mind you, chemical reader, the Doctor's use of the word "efflorescence" is in a sense different to that to which you and we have, hitherto, been accustomed. We have also his Laws of Symmetry, Sphericity, &c. &c. The author is deterred by no difficulty, and is so facile in explanation that it is evident he has missed his time and place in history. The old Greek schools are, alas! no more; there, surrounded by his disciples, the Doctor would have explained everything, easily, fluently, and in most classic Greek; and his explanations would have wanted nothing save, perhaps (which is a mere trifle), intelligibility. Reader, go with us through the heads of the various sections of his first chapter, which, by the way, follows an introduction of eighty pages; the work itself consisting of one hundred and twenty pages! We take the headings of the paragraphs:—

"1. The Aim of Science, What?

"2. An Explanation, What?

"3. The Conditions of a full Explanation.

"4. A full Explanation is not possible to Man.

"5. Explanation by Law is good, so far as it goes.

"6. Law cannot be a Last Word to Philosophy.

"7. But God the Author of all.

"8. An Opening also must be kept for Miracles.

"9. Law and Miracle are equally Products of God's essential Attributes.

"10. Creation must be expressive of God's essential Attributes.

"11. Power, Unity, Immutability, to be looked for in its First Elements.

"12. No Construction *à priori* should be attempted.

"13. But the Senses require to be supplemented by Reason.

"14. The Danger of Hypotheses."

Here we stop to note a melancholy instance of how people are self deceived. Here is a thinker who is perpetually occupied in framing hypotheses, most of them of about equal calibre with the old molecular hypothesis of hooks and rings; and yet he writes the following without knowing it to be a hideous satire upon himself:—"It is not the mere existence of hypotheses that is to be deplored, but it is the facility of their construction and their pretensions in undisciplined minds. One may form them by the dozen in a forenoon, and not be much exhausted after all. And yet no sooner is one formed by an undisciplined mind than it proceeds to take possession of the field of inquiry, and to urge its claims to belief with all the warmth that would be due to the actual voice of Nature, were she to repeat herself legitimately, by way of echo, in the observer's soul. Hence the danger of hypothesis."—P. 5.

Now, after reading the Doctor's ideas upon the danger of undisciplined minds framing hypotheses, let us read his hypothesis as to why sweet things are sweet. Here is scope for hypothesis with a vengeance. If any other philosopher of the present day, than Dr. Macvicar, had been asked why sweet things were sweet, he would undoubtedly say "Really I have not the least idea." But the Doctor found it not even an intellectual feat, he doubtless formed it with a dozen others, without fatigue, in the course of a forenoon. He says, at p. 67:—"And here we might venture a conjecture as to the possible cause of such a sensation as that of sweetness. Suppose there existed in the sentient organisation of the tongue, molecular parts in the state of HOC, whose destiny in the order of nature, is to be transformed into HCO, it follows, from our third law of being, that the access of particles of HCO to these sentient parts, will facilitate and tend to effect that change in their organisation. Now, such a change being the fulfilment of their destiny, we may suppose to be agreeable or sweet." Therefore a pleasant taste is always sweet. Therefore because Jack Styles was hanged in fulfilment of his destiny, hanging is sweet! Oh! Dr. Macvicar, if this be sanity, what is insanity?

The Doctor tells us at p. 101 why insects have such imperfect livers; his reason is as eccentric as the last-quoted hypothesis; but as even sweetness may, if indulged in too much, produce cloying, we do quote it. We cannot, however, refrain from quoting a question asked of Nature by Dr. Macvicar, at p. 79 of the Introduction. Nature for some unexplained reason, declined answering the query, Doctor, with his usual facility, answered the query himself. "Is silica, then, the *caput mortuum* in the economy of Nature, and is the quantity of it any

planet a measure of the antiquity of that planet? To this it is to be answered that, viewed in the light of our theory, there is no teraqueous species which comprises in its structure more of the elements of stability than silica. But its poles are capped with oxygen; and oxygen can never rest. Nay, it is determined what to do. Under the Law of Being, as we have seen, every species is, as it were, animated by its own history, and aims at repeating the past, and in re-establishing its original type or typical combination." *A-propos* of capping poles we have a very odd sentence, at p. 69, under the heading "Styptic,"—"The most independent way in which C O can attain to homopolarity, is that, in which it attains at the same time to the most requisite regularity,—viz. by inducing an atom of C into its empty pole,"—it seems almost dishonest to stop the quotation at a comma, but we pledge ourselves that if we had gone on to the period it would have answered no purpose.

We might tell how the author talks of "the goodness of C coming to the relief of H—Hypnic coming to the relief of Pungent," (p. 46,) and many other equally absurd paragraphs might be quoted,—but we refrain; it would be useless. If any one wants an evening's amusement, let him pay five shillings and get the book; but, although he will commence by laughing, he will end by sorrowing to think that a scholar, a gentleman, and a Christian priest should allow an over-active and highly-ingenious brain to run riot in absurd fancies and speculation. The author's diagrams are exquisitely beautiful. His models, from which probably they are copied, are charming to look at. They are made of pieces of wire fastened, while warm, to small balls of gutta percha. In conclusion, permit us respectfully to express a hope that instead of heading unintelligible chapters "Philosophy Simplified," and writing books that no one will read, save out of curiosity, our author will devote himself to some simple train of scientific investigation;—to so deeply a read man it will not be difficult to find a subject,—let him accumulate facts, but leave others to speculate upon them.

The First Step in Chemistry: a New Method for Teaching the Elements of the Science, by Robert Galloway, F.C.S. Third Edition. London: John Churchill, New Burlington Street.

This little work will be likely to prove useful to many teachers of Chemistry to whom it is an object to give students—many of them perhaps very young—more insight into the elements of the science than is to be gained by an occasional hour in a laboratory. The author commences at the beginning of Chemical Physics, describing clearly the different states of matter, meaning of the term "elements," properties of matter, laws of combination, chemical notation, decomposition, affinity and its modifications under the influence of heat, &c., bases, acids, and salts, and so forth, appending to each chapter simple exercises to illustrate the points just explained, and to better impress them on the students' minds. This method of instruction seems likely to meet with considerable success in schools and other establishments where a study of Chemistry is not a chief branch of education, but must take its place by the side of Latin and Greek; and, as such, it gives us pleasure in being able to cordially recommend this useful little book.

CORRESPONDENCE.

Infinite Divisibility of Matter.

To the Editor of the Chemical News.

Sir,—I am sorry to have again to occupy your valuable space, but a misconstruction of my last letter renders it almost necessary that I should do so. The misconstruction to which I refer, although in itself small, entirely perverts the general meaning of my letter, and, therefore, necessitates some notice being taken of it.

Mr. Barrett thus misquotes in his last letter:—"'Ultimatum' thinks it has been already *proved* a fact, for he says that the *proofs* are so well known that they do not require recapitulation." Now, the words "proofs" or "proved" do not occur in any part of my letter, and if Mr. Barrett cannot distinguish a difference between the words "proofs" and "arguments," certainly his powers of generalisation cannot be of any mean order.

Mr. Barrett need, I think, scarcely be under any apprehension that we suppose him guilty of propounding a "new theory;" indeed, the most distinctive feature of his proposition consists in the entire absence of originality, for there is not one of his "axioms" which has not been repeated over and over again, times without number, within the last thirty years. He also complains of "hypotheses being set down as facts so quickly." Now, there is no theory in existence which has been so rigorously tested, and so unsparingly probed, as that of ultimate molecules. It has now for many years withstood all the efforts of some of our most distinguished *savans* to find a single hole in its coat, to discover one discrepancy in its application, or to perceive anything unsatisfactory in it except our own weak-sightedness.

Thus, negatively, is the atomic theory confirmed, and almost rendered a certainty. Positively, it receives a double confirmation by the recent researches into the laws of electricity, and more especially into the laws of heat and light. Hence, he who would shake our faith in the theory of molecules, must do so by showing that it is not compatible with the various phenomena of heat, light, electricity, chemical combination, and what is at present known as molecular change, or allotropic modification.

Not only must he show that the theory and phenomena are incompatible, but he must also show that the theory which he advocates gives a more satisfactory explanation of these phenomena.

Mr. Barrett says:—"At present I have only examined the old hypothesis." For my part, I cannot see the utility of exhuming and parading before our eyes the old mummery—"infinite divisibility"—unless some new beauty is to be exhibited, some new mode of application shown, or some hitherto undiscovered force to be pointed out. Do not haunt the "new theory" with the spectre of the "old" until it is clearly demonstrated that the former is a usurper.

Mr. Barrett does not seem to be at present prepared to commence the overthrow and demolition of the "atomic theory." Waiting patiently, however, to hear of the *coup de foudre* which will bring down along with it the laws of heat, electricity, chemical combination, &c.—I am, &c. Ultimatum.

Glasgow.

A Guide for Analysts.

To the Editor of the Chemical News.

Sir,—In a review of Mr. Bullock's translation of the fourth German edition of "Fresenius's Quantitative Chemical Analysis," you observed that "The comments and experiments made by the author upon the numerous new processes which have been from time to time proposed were especially valuable. It was an inestimable boon to be able to fall back upon the critical acumen of so skilled an analyst as Dr. Fresenius in forming an opinion on the feasibility of some plausible process, instead of being dependent upon the laudatory description of the inventor." A plan so admirable as that of informing the reader, from the personal experiments of the writer, what fresh methods he may with advantage adopt and what he should avoid, might be extended by the (say) quarterly

publication of a Guide for Analysts, issued, I would suggest, by the Chemical Society. Carefully conducted, and with a staff of named contributors whose judgment might be relied upon, the work could contain brief, pithy notices of the more important among the new modes of analysis which may have lately appeared; each notice being followed by the writer's opinion, founded on his own personal experience, of the process; and, by a statement of any objection, difficulty, modification, or improvement, found or made by the critic, while testing that process.

Such a guide would not fail to be appreciated by the analyst, who would, in many cases, at least, prefer trusting to the judgment of an impartial observer, than to the naturally favourable opinion of the inventor himself.—I am, &c.

T. W. S.

Mounting Microscopic Objects.

To the Editor of the Chemical News.

Sir,—In allusion to the requirements of your Correspondent, "W. M. S——s, M.D.," as indicated in the Chemical News of December 15th, I would suggest the following system of operating as likely to prove of service in the mounting of small objects intended for microscopical examination:—

Proceed, in accordance with your Correspondent's usual practice, to soften or dissolve the hard organic tissues by the employment of caustic potassa or strong acetic acid, and then wash with water. The desideratum consists now in devising some means of replacing water in the structure of the organism by Canada balsam; and this will, I believe, be found easy of accomplishment by the employment successively of alcohol and benzol (rectified coal-tar naphtha). Thus, if, for example, a water-moistened fabric be immersed in strong alcohol for a short time, then removed and transferred to benzol, and, after remaining in this latter for an interval sufficiently long to allow of the replacement of one liquid by another, it will now be possible to ensure a speedy saturation of the fabric by Canada balsam on treatment finally with that medium.

The precautions necessary to be observed in applying this process to the mounting of microscopic objects may be enumerated as follows:—

1. That ample time be allowed at each stage of the treatment for the tolerably complete withdrawal by exosmosis of the liquid already contained in the structural cavities of the organism, and for the penetration of the new fluid.

2. That whenever the nature of the object will admit, the superfluous liquid be removed by draining on bibulous paper, or other means, with the view of saving both time and material in the after treatment; but where, from delicacy of structure, this is not possible, a more liberal allowance of the several liquids will be imperative.

Such a process will not, I believe, be found either expensive or difficult of execution, although, from the necessary employment of many fluids in succession, it may not be able also to claim the advantage of expedition.—I am, &c.

John Spiller.

Writing-Ink.

To the Editor of the Chemical News.

Sir,—M. de Champour and M. F. Malepeyre, in their Manual, say that Ribaucourt's ink is one of the best at present in use. The formula for its preparation, which may interest some of your readers, is as follows:—

Aleppo galls, in coarse powder .	8 ounces
Logwood chips	4 ,,
Sulphate of iron	4 ,,
Powdered gum-arabic . . .	3 ,,
Sulphate of copper . . .	1 ,,
Crystallised sugar . . .	1 ,,

Boil the galls and logwood together in 12lbs. of water for an hour, or till half the water has been evaporated; strain the decoction through a hair-sieve, and add the other ingredients; stir till the whole, especially the gum, be dissolved; and then leave at rest for 24 hours, when the ink is to be poured off into glass bottles and carefully corked.—I am, &c.

A Country Subscriber.

[A Correspondent, Mr. J. Horsley, has favoured us with the following receipt for a good chemical writing fluid:—Triturate in a mortar 36 grains of gallic acid with $3\frac{1}{2}$ ounces of strong decoction of logwood, put it into an 8-ounce bottle, together with 1 ounce of strong ammonia. Next dissolve 1 ounce of sulphate of iron in half-an-ounce of distilled water by the aid of heat; mix the solutions together by a few minutes' agitation, when a good ink will be formed, perfectly clear, which will keep good any length of time without depositing, thickening, or growing mouldy, which latter quality is a great desideratum, as ink undergoing that change becomes worthless. It will not do to mix with ordinary ink, nor must greasy paper be used for writing on with it.—Ed. C. N.]

Chemical Notices from Foreign Sources.

1. MINERAL CHEMISTRY.

Oxygenated Combinations of Nitrogen.—As the binoxide of nitrogen and hyponitric acid correspond to four volumes of vapour, they ought to be diatomic, and therefore not able to replace one atom of hydrogen in organic compounds. From this it follows that the radicals of nitric and nitrous acids are molecules different from binoxide of nitrogen and hyponitric acid. Thus, the nitrated combinations contain the radical of nitric and not hyponitric acid; and the bodies in which it has been hitherto supposed that the binoxide of nitrogen was substituted for hydrogen, contain, on the contrary, the radical of nitrous acid. The proof that it is so, lies in the fact that, in the preparation of all these bodies we employ nitric acid, nitrites, or nitrous anhydride.

Weltzien now shows clearly (*Annalen der Chemie und Pharmacie*, bd. cxv. s. 213) that the diatomic binoxide of nitrogen $(NO_2)''$ can replace two atoms of hydrogen, while its isomer, the monatomic radical of nitrous acid $(NO_1)'$, can only replace one atom of hydrogen.

When an excess of hyponitric acid is added to sulphuric acid, the whole becomes a crystalline mass. This drained on a tile of porous earth, and dried under a bell-glass, over sulphuric acid, is found to have a composition represented by the formula—

$$2\left.\begin{matrix}(S_2O_4)''\\(NO_2)''\end{matrix}\right\}O_4 + \left.\begin{matrix}(S_2O_4)''\\H_2\end{matrix}\right\}O_4 + 2\,Aq.$$

It is a compound of sulphuric acid with two molecules of a sulphuric acid in which two atoms of hydrogen have been replaced by the diatomic binoxide of nitrogen.

On the other hand, if we add anhydrous nitrous acid to hydrate of sulphuric acid, a crystalline mass is formed, which, dried like the former and analysed, gives results which accord with the formula—

$$\left.\begin{matrix}(S_2O_4)''\\H.(NO_2)'\end{matrix}\right\}O_4$$

This body represents hydrated sulphuric acid, in which one atom of basic hydrogen has been replaced by the monatomic radical of nitrous acid. So in the bodies which result from the action of hydrochloric acid on nitric acid, chloronitrous and chlorohyponitric acids, the author supposes that the former $\left.\begin{matrix}(NO_2)'\\Cl\end{matrix}\right\}$ contains the monatomic radical of nitrous acid, and the second $\left.\begin{matrix}(NO_2)''\\Cl\end{matrix}\right\}$ the diatomic binoxide of nitrogen.

When dry nitrate of silver is acted on by chlorine,

anhydrous nitric acid is formed: that is to say, a compound of the monatomic radical $(NO_4)'$.

$$\underbrace{\left.\begin{matrix}(NO_4)'\\(NO_4)'\end{matrix}\right\}O_2}$$

Anhydrous nitric acid.

But when iodine reacts on dry nitrate of silver, hyponitric acid, $(NO_2)''O_2$, a compound of the diatomic radical binoxide of nitrogen, is disengaged, and iodate of silver is formed. This reaction is explained by the following equation:—

$$3\left.\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2 + 3I = 3\left((NO_2)''O_2\right) + \left.\begin{matrix}IO_4\\Ag\end{matrix}\right\}O_2 + 2\left.\begin{matrix}I\\Ag\end{matrix}\right\}$$

The author's researches show that in the oxygenated combinations of nitrogen the same group, NO_2, behaves sometimes as a monatomic and sometimes as a diatomic radical. In the hydrocarbon radicals an even or uneven number of hydrogen atoms determines what the author calls *even* or *uneven atomicity*. The oxynitro radicals, on the contrary, behave like a certain number of the metals, which are sometimes monatomic and sometimes diatomic.

The protoxide of nitrogen is regarded by the author as an oxidated ammonia, in which three atoms of hydrogen are replaced by one atom of nitrogen. Griess has shown that H_2 may be replaced by N.

The Fluozirconates and the Formula of Zirconia.—We must refer our readers to the *Annales de Chimie et de Physique* of November, for some researches on the chemistry and crystallography of the fluozirconates by Marignac which will not allow of condensation. The author believes the atomic number of zirconium calculated by Berzelius 44·68, to be rather too low, and proposes 45, but does not pretend to consider that number rigorously exact. In opposition to Svanberg, who has asserted that zirconia is a mixture of three distinct metallic oxides, the author says that "nothing in the course of his experiments appeared to justify the idea that zirconia was not a single and perfectly homogeneous principle." He states, also, that his experiments prove beyond all doubt that the formula for zirconia proposed by Deville and Troost, ZrO_2, is the true one.

II. ORGANIC CHEMISTRY.

Products of the Oxidation of Legumine and Gelatine.—Froehde has found (*Journal für praktische Chemie*, bd. lxxix. s. 303) that when legumine is oxidised by means of sulphuric acid and bichromate of potash, there are formed benzoic acid, the fat acids from formic acid to caprylic, valeronitrile, acetonitrile, and another intermediate, either butyronitrile or propionitrile. Gelatine, under the same circumstances, besides the fat acids, gives hydrocyanic acid, hydruret of benzoyle, and the acetic, propionic, butyric and valeric nitriles. On separating the preceding nitriles by fractional distillation, the author found that their boiling points agreed exactly with those of the alcohols containing the same number of carbon atoms.

Manufacture of Yellow Prussiate of Potash.—R. Hoffmann has studied the manufacture of yellow prussiate, with a view to try and account for the great disproportion which exists between the quantity of potash employed and that of the product. The principal conclusions he has come to are the following:—1. Carbonate of potash is not altered by fusion with iron, and is not sensibly volatilised at a bright red heat. 2. In presence of animal matters it produces from beginning to end of the fusion cyanide and sulphocyanide of potassium. 3. The sulphocyanide is formed at the expense of the sulphur in the animal matters; for sulphate of potash mixed with the carbonate is changed in presence of iron, and charcoal into the double sulphide of iron and potassium and carbonate of potash. 4. The gases disengaged from the animal matters protect the cyanide of potassium formed from the decomposing action of oxygen and the vapour of water. 5. In ordinary operations the fused mixture does not appear to contain cyanate of potash. 6. Direct observation seems at first sight to confirm the fact of the volatilisation of salts of potash during the fusion. Much more potash is consumed than is recovered in different states after the operation, and an abundant deposit of chloride of potassium and sulphate of potash is found in the chimney. 7. The double sulphide of iron and potassium found in the residue after treating the fused mass with cold water, dissolves in boiling water, giving a green coloured solution. Boiling this double cyanide (which the author regards as FeS + KS) with cyanide of potassium changes it into yellow cyanide, with a small quantity of sulphocyanide of potassium. This re-action does not take place when the solution contains large quantities of other salts. 8. The greater part of the silica forms a compound, insoluble in cold water, containing potash, the earths, and some iron; but a part remains in the mother liquor as silicate of potash, and so passes into the residues which serve for another fusion. The analytical results on which the above conclusions are founded will be found at length in the paper by the author in the *Annalen der Chemie und Pharmacie*, bd. cxiii. p. 81.

Isomeric Organic Compounds.—M. Beilstein (*Répertoire de Chimie pure et appliquée*, November, 1860, p. 408) establishes the identity of bichlorinated toluene with the chlorobenzol of Cahours. The author obtained his toluene from commercial benzol, and converted it into bichlorinated toluene by the action of chlorine. The compound boils at 201° C., the vapour excites tears; it is colourless at first, but becomes coloured after a time. Its taste is burning. It is insoluble in water, but soluble in alcohol and ether. The density is 1·256 at 13° C. The reactions of the oxides of silver and mercury and the nitrate, oxalate, acetate and benzoate of silver on this body are exactly the same as those of the same bodies on chlorobenzol. Thus, by acting on bichlorinated toluene by benzoate and acetate of silver, the author obtained corresponding compound ethers. He found also that the reaction of ethylate of soda, alcoholic ammonia, sulphocyanide of potassium, sodium, and strong sulphuric acid on the two bodies were identical.

Artificial Preparation of Para-Tartaric Acid.—The acid artificially prepared by MM. Perkin and Duppa (Chemical News, vol. i. p. 244) is said by M. Pasteur (*Répert. de Chimie pure et appliquée*, November, 1860, p. 419) to be para-tartaric acid. The opinion is founded on the optical properties of the crystals. Kekulé has also formed para-tartaric acid from bibromo-succinic acid. He made the latter acid by heating in sealed tubes to 150° or 180° C. 12 parts of succinic acid, 33 parts of bromine, and 12 parts of water. (The action will take place at 100°, but it will be slow.) When the action is finished the mass is found to be transformed into small grayish crystals. When the tube is opened, a good deal of hydrobromic acid escapes. The product is washed with cold water while in the tube. It is then dissolved in boiling water and treated with animal charcoal. On cooling, large and perfectly white crystals are obtained, the mother liquor from which will furnish more. The analysis of these crystals led to the formula—

$$\begin{matrix}H_4\\Br_2\end{matrix}\ \overset{O_4}{\overset{O_4}{}}$$

which is that of bibromo-succinic acid. To obtain the tartaric acid from the decomposed bibromo-succinate of silver, the author treated the filtered solution with hydrosulphuric acid. After another filtration, the excess of sulphuretted hydrogen was driven off by evaporation; the liquor was then neutralised with ammonia, and any excess of ammonia being got rid of by boiling chloride of

barium was added. The tartrate of baryta precipitated was decomposed by sulphuric acid, and, after separating the sulphate of baryta, the solution, on evaporation, yielded crystals which the author has since proved to be para-tartaric acid.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following is a Syllabus of the Course of Six Lectures on "The Chemical History of a Candle"—(adapted to a Juvenile Auditory)—by Michael Faraday, Esq., D.C.L. F.R.S. &c., Fullerian Professor of Chemistry, R.I. To be delivered on December 27th and 29th, 1860, and on January 1st, 3rd, 5th, and 8th, 1861, at three o'clock:—

A Candle: The flame—its sources—structure—mobility brightness.

Products: Water from the combustion—nature of water—a compound—hydrogen.

Hydrogen in the candle—burns into water—the other part of water—oxygen.

Oxygen present in the air—nature of the atmosphere—its properties.

Other products from the candle—carbonic acid—its properties.

Carbon or charcoal—coal gas—respiration and its analogy to the burning of a candle—Conclusion.

Importance of Ventilation.—Passing from the private shop to public institutions we are compelled to admit the same radical fault—the want of that element which is "the breath of life." In our churches, schools, and assemblies, people who go there suffer more or less from this evil. It is proverbial how persons, young and old, suffer from colds, bronchitis, and influenza; all of which are said to be "caught" when they return from some public place of assembly. The question naturally arises, How is this? The answer is that it is caused by the sudden change which the body undergoes in passing from a heated impure air to that of the natural temperature, containing also its proper proportion of elements. Man requires for his health one gallon of air every minute of his life; the individuals of a church congregation are rarely, if ever, supplied with that quantity. Only at the cathedrals is the air space in proportion to the worshippers. A man of large lungs inhales about twenty-five cubic inches of air at each respiration; he breathes eleven times a minute, and thus requires nine and a-half cubic feet of air every hour. Now, when there are a thousand persons under one roof (some of the metropolitan churches and chapels contain 2500 persons) for a couple of hours, it is evident that twenty thousand cubic feet of air are required to supply that which is necessary for existence to these thousand persons in a pure atmosphere, so that of course a much larger quantity than that is required in order that a current can be established to remove the effete matter of exhalation. The evils of vitiated air are also more to be guarded against, because persons can live in it without being aware of its danger, as far as their sensations are concerned. When we enter a crowded assembly on a cold day the air is always at first repulsive and oppressive; but these sensations gradually disappear, and we then breathe freely, and are unconscious of the quality of the air. Science, however, reveals the fact that the system sinks in action to meet the conditions of the impure air, but it does so at the expense of having the vital functions gradually depressed, and when this is continued disease follows. No disease can be thoroughly cured when there is a want of ventilation. It is related that illness continued in a family until a pane of glass was accidentally broken, and then it ceased; the window not being repaired, a plentiful supply of fresh air was admitted The practice of building sepulchral vaults under the churches was fraught with the greatest evil to the health of those who went into the edifice for sacred purposes. But with few exceptions it is now interdicted by the Legislature; still a great deal in the way of improvement has to be done. Nearly all the churches in the empire require some artificial means of ventilation to render them physically fit receptacles for the body during a prolonged service. The Sunday-schools also, as a general rule, are very ill-ventilated; and lessons in the second hour are far worse rendered than in the first, solely arising from a semi-lethargic coma that comes over the pupils breathing a carbonic air which has already done duty and been inhaled by others several times. However it is to be regretted, it is yet true, that people will, sometimes, sleep during the sermon. Now, the minister must not be twitted with this, for with the oratory of a Jeremy Taylor or a Tillotson people could not be kept awake in an atmosphere charged with carbonic gas, the emanations of a thousand listeners. The churchwardens should ventilate the churches, and see that the congregations have sufficient air for breathing; if people go to sleep, they are more to blame than the preacher.—*Piesse's Laboratory of Chemical Wonders.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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*** All *Editorial Communications* are to be addressed to Mr. Crookes and *Advertisements* and *Business Communications* to the Publishers C. Mitchell & Co., at the Office, 12, Red Lion Court, Fleet Street London, E.C.

G. J. Johnson.—We are much obliged for your good wishes. The proposed change in size and price seems to give general satisfaction. We will insert your queries.

Chromate of Lead.—A correspondent writes "What is the best precipitant, and in what manner should it be used to throw down a chromate of lead of a lemon yellow colour, so as to mix it with a blue, to form a bright light green? I have always precipitated the chromate of lead too much of an orange colour, consequently the green has been more of a sage-leaf colour instead of a grass green. In other words, what will be the best mode of making a good bright grass green with a mixture of blue and yellow, so as to avoid using the poisonous compound, arsenite of copper." Will any of our correspondents favour us with information on this point?

A Country Subscriber.—The fluid writing ink is very good, and as you say it would not cost more than 2d. per gallon, it could not fail to be appreciated by the public. The other ink is also good, but of less importance. The green is unfortunately a transparent instead of an opaque colour, and is not quite so bright as arsenite of copper; being so cheap, it would, however, be of considerable value.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Theory of Nitrification, by Mr. E. MILLON.

IN two previous meetings of the Academy, Marshal Vaillant communicated a brief summary of the results of the works undertaken in Algeria to explain in a chemical point of view the phenomena of nitrification. The object of these first communications was to show that the progress of nitrification depends mainly on the elevation of the temperature at which the earth and atmosphere are maintained during several months of the year. Under such conditions nitre always forms with regularity, provided that a humic product, salts of ammonia, and a mixture of earthy and alkaline carbonates are present. Furthermore, the solid mass furnished by the preceding matters must be moistened with water and oxygenated by air. These conditions are so well defined that a soil lacking alkali, humic acid, or ammonia, ceases to produce nitre; but when the absent principle is restored nitrification recommences directly.

The verification of this fundamental law has been greatly diversified, accepting it in the first instance simply as the result of experience; afterwards it was endeavoured to establish the theory of it,—that is to say, to connect it with other known chemical facts. Obviously, the substance, the presence and necessity of which is not evident, is the humic principle. What part does it play, and what is its use as regards the fixed and volatile alkali when the latter is oxidised by air, furnishing nitrogen, an essential element of nitre?

The intervention of humus, natural or artificial (its origin matters little), gives, nevertheless, the key to nitrification. The alkaline humate formed by the blending of the materials indispensable to nitrification absorbs energetically the atmospheric oxygen; and this oxidation of the humic acid is the cause of the oxidation of the ammonia. It is an influence arising from proximity,—a catalytic action. Combustion establishes itself in the cold in the midst of the surrounding substances, and the humus while burning occasions the combustion of the ammonia. Further on we shall adopt a word to express as nearly as possible this simultaneous oxidation of humus and ammonia. For the present it will suffice to state that this affinity is so natural that it has been found possible to substitute very different substances for the humus. As exemplifying these special combustions, we adduce those obtained with phosphorus, copper, and iron. These three elements, so different in their nature, can be substituted respectively for the humus, and can excite in the cold by their own combustion the nitrification of the ammonia, contact with air being sufficient to induce the reaction.

Here are some details of these new experiments:—In a glass globe of six to eight litres place a stick of phosphorus and a sufficient quantity of slightly ammoniacal water to half cover it. The slow combustion of the phosphorus commences immediately, and at the same time that of the ammonia is established; the products of combustion are condensed in the water, and among them is found nitric acid.

In the preceding experiment carbonate of ammonia may replace ammoniacal water; but this is not the case either with the sulphate or the hydrochlorate of ammonia. These two salts do not produce nitre, and it is to be presumed that nitrification takes place at the expense of the uncovered part of the phosphorus, between the volatile principles, water, air, and ammonia, or carbonate of ammonia. Nitrification may be called a semi-aërial phenomenon when it is not accomplished entirely in the atmosphere.

By employing metallic copper in place of phosphorus oxidation of ammonia is again established and developes itself energetically; nitrite and nitrate are simultaneously produced, and this formation of oxygenated compounds and of nitrogen is abundant in comparison to that observed to take place with phosphorus, and above all, with iron. I therefore recommend the following experiment to prove the combustion of ammonia in these kinds of reaction. The following is the operation:—Moisten copper turnings, introduced into a large glass balloon, with sufficient caustic ammonia to wet the metal without submerging it. When the brilliant surface of the copper becomes tarnished scrape it, shaking it meanwhile with the ammoniacal liquid; and when the latter ceases to dissolve the oxidised products, pour into the balloon a fresh quantity of caustic ammonia. Finally, employ a sufficient quantity of ammonia to obtain a complete solution, and to the blue liquor, which must be decanted, add some baryta water. Boil the whole; the ammonia is disengaged and the oxide of copper precipitated. Filter the solution, and there will remain only a liquid containing nitrate and nitrite of baryta, with the baryta in excess. It is interesting to remark that it is in the midst of the reaction of ammonia and air on copper, or, in other words, by the aid of ammoniacocupric liquor, that the solution of lignin is accomplished.

Metallic iron is operated upon in the same manner as copper, but the production of nitre is much slower and infinitely less. In this case there is, in the affinities put in operation, a tendency which opposes nitrification,—namely, that of iron to reduce nitric acid. The effect of this influence is to slacken and arrest the oxydation of ammonia. But that which interprets this last production of nitre,—feeble as it is,—altogether in favour of the theory of simultaneous oxidation, is the absolute impossibility of substituting peroxide of iron for metallic iron.

It is well known that the reduction of peroxide of iron by ammonia is the pivot of all the recently-expressed opinions on the subject of nitrification. The greatest weight is due to the opinion of those eminent chemists who have developed this theory in full; but I owe it to truth to state, that though the most varied attempts have

been made to oxidise ammonia in the cold by peroxide of iron, they have all proved unavailing. I have never obtained the least indication of nitrification. Thus, at the temperature of the air, iron acts as an oxidising agent on ammonia, and, under the same conditions, ammonia remains intact in presence of the peroxide of this metal.

These results are not surprising, if the theory I have explained be admitted; and this new method of oxydation will doubtless henceforth have developments as simple and regular as those incident to the laws of double decomposition, or to the displacement of base and acid, or to organic substitutions.

As to the extension of this theory, it is not circumscribed by the facts here adduced. Numerous examples could doubtless be found among existing facts, and many others could be discovered and added to the preceding; but, at the outset, I content myself with well defining the reactions obtained by employing substances of characteristic diversity.

Analogies easy to be apprehended will certainly conduct further. Why should not other organic matters act in the same manner as humic compounds? Why should copper, phosphorus, and iron be the only bodies whose combustion provokes that of ammonia? If the substance which brings about oxidation presents great variety in nature and origin, the substance submitted to the attraction will not be less subject to variation. By borrowing some of the facts observed by M. Schœnbein, it can be easily shown that ammonia is not the only body susceptible of burning in presence of phosphorus at the temperature of the air. I need only cite the beautiful experiment of half immersing a bar of phosphorus in a colourless solution of a salt of manganese, sulphate or chloride, when it speedily imparts to it a rich violet tint. Finally, it is easy to predict, that in this agreement and grouping of affinities, corresponding oxidation is not the only effect produced.

Instead of more or less undergoing combustion in proximity to copper, phosphorus, humic acid, or their analogues, it is possible that an organic substance, insoluble, like lignin, should dissolve, or rather divide into more simple molecules; again, it is possible that various principles indifferent to each other should combine on receiving the chemical impulse established by this slow and spontaneous combustion. Let us imagine chemical action carried in the most varied directions, with the progress, the duration, and within the limits of the temperature pertaining to life itself, and it seems to me we shall have a general idea of the path opened by the methodical study of nitrification.—*Comptes-Rendus.*

Note on Kavaine and Methysticine, by* W. Procter, *Jun.

The substance which constitutes the subject of this notice is derived from the plant described as *Piper methysticum*,—the "Cava" of Captain Cook and the "Kava" of other writers and observers of the productions of the South Sea Islands. The root is both chewed and made into a drink, with a view to its exhilarating effects on the nervous system. The process of making cava as a beverage is described graphically by Mariner, in his "History of the Tonga Islands," and is quoted by Mr. Morson in a notice published at page 474, vol. iii. of the *Pharmaceutical Journal*. Recently Dr. S. Weir Mitchell presented us with a specimen of marked "Kavaïne," which he had received from Dr. Trist, of the U. S. Navy, who obtained it at Tahiti from a French apothecary at that place, and who had made it from the kava. We were about to make an examination of this substance when the *Journal de Pharmacie* for January, 1860, came to hand, in which M. Gobley has published some researches on the "Kawa" root and its chemical constituents, among which, under the name of *Methysticine*, he describes a crystalline substance which we at first supposed to be the Kavaïne of Dr. Trist.

Methysticine is in colourless white and silky needles, has neither odour, nor taste, or reaction with litmus, and fuses at 266° F., decomposed at a higher temperature. It is insoluble in water, and but little soluble in alcohol, and ether, and in hot volatile oils. Its best solvent is boiling alcohol, from which it separates by cooling in crystals. It is soluble in hydrochloric acid with a yellow colour. Nitric acid dissolves it with first a yellow, and then an orange colour, without turning red. Pure SO_3 is coloured by it beautifully violet, whilst commercial oil of vitriol assumes a deep red colouration.

M. Gobley at first supposed this substance to be piperin, with which it is analogous; but it differs from piperin, 1st, in its crystalline form; 2nd, in its fusing point; 3rd, by the reaction of NO_5 and SO_3; and lastly, by its composition, which is as follows:—

Carbon	62·03
Hydrogen	6·10
Nitrogen	1·12
Oxygen	30·75
	100·00

The specimen of kavaïne from Dr. Mitchell is in beautifully white and brilliant prisms, *soluble* in water, nearly insoluble in alcohol; are insoluble in ether, soluble in concentrated nitric acid without reaction or colouration; soluble in sulphuric acid, and, when heated, the solution acquires a brownish colour. It fuses when heated, first losing its transparence, and with further heat yields a voluminous charcoal, and, finally, an alkaline ash. It is neutral to test-papers; has little taste, and no odour. From these facts, it is evidently a different substance from methysticin, possibly an organic salt. We propose at a leisure moment to examine it more closely.

M. Gobley also isolated from kava a soft resin, which is soluble in alcohol, and remains in the mother liquids, from which methysticine is crystallised. Its colour is greenish yellow; its odour aromatic; its taste acrid and biting, and excites salivation. It fuses at 122° F.; is insoluble in water, and soluble in alcohol and ether; and communicates to SO_3 an intense red colour, like pepper resin. M. Gobley believes that the physiological effects of kava are attributable to this constituent. Besides these two substances, *cellulose*, *starch*, gum, and various salts were found.

Dr. O'Rocke, who sent the kava to M. Gobley, says that it has a decided therapeutic action, and is one of the most powerful sudorifics that he is acquainted with, and also has a direction to the mucous surfaces, as do other varieties of the pepper tribe.—*American Journal of Pharmacy.*

TECHNICAL CHEMISTRY.

On the Preparation of Peroxide of Manganese, by M. Bœttger.

The method pointed out by M. Bœttger for preparing pure oxide of lead by means of acetate and chloride of

lime succeeds equally in precipitating oxide of manganese from its solutions in the state of peroxide. Thus, if a solution of chloride of manganese is boiled with excess of the solution of hypochlorite of lime, peroxide of manganese is obtained, but, at the same time, permanganate of lime, which imparts a purple colour to the fluid, is also obtained with the acetate of manganese.—*Journal de Pharmacie et de Chimie*, t. xxxviii.

PROCEEDINGS OF SOCIETIES.

SOUTH KENSINGTON MUSEUM.

On Food, by Edwin Lankester, *M.D., F.R.S.*

Lecture IV. *On Oil, Butter, and Fat.*

(*Continued from page* 331.)

I will next call your attention to the fact that through out the body there is a tissue called adipose tissue, or fat when it is separated—this adipose tissue is always present when animals are in health. It is that tissue which disappears when people are suffering under disease, and it is the absence of that which makes them grow thin and ugly when they are old,—I say ugly, on account of the contrast between them and the young with their sleek and fat rounded outlines of beauty. Now this substance lies in little cells under the tissue, and by a microscope you can easily see the cells in which the oily matter is deposited. The uses of this adipose tissue in system are very manifest. It acts as a supply of fuel in times of scarcity, just as we take care in the summer-time to fill our coal-cellars with coal, so it would seem that Nature takes care in the summer-time that animals should lay up large quantities of this coal or fat as a store of fuel for the cold. We find it deposited on the backs of animals in temperate climates; the starch and sugar of the grasses which they take are converted into fat and put upon their backs. Thus the dormouse and the hedgehog and various animals which hibernate are very fat in the summer, but in the winter, when they get no food, that fat is consumed, and they come out of their sleep thin and lean. A man is fatter in the summer-time than in the winter. Some persons think they get no fatter in the summer than in in winter. Some persons think they get thinner in summer. The real consumer of heat is the cold winter, and just as the proportion of intensity of cold in winter will be the quantity of fat which is lost; persons who live in cold climates seldom get fat. This has been proved in this country very singularly. In prisons they give the same diet in winter and summer, and in both these cases the report shows that the prisoners are always fattest at the latter end of summer, and thinnest at the beginning of March, and so they go on alternating. Thus showing that the influence of the fat is to supply the blood when the blood is destitute of combustible materials. But there are many secondary purposes which fat subserves, such as lightening the body. The fat man in proportion to his size weighs lighter than the lean one, and so it is with animals. The whales, dolphins, porpoises, and creatures of that sort, are supplied with enormous quantities of fat, to enable them to move in water, and, it it were not for that, they would be unable to pursue their prey or live in the water. And it is also a non-conductor of heat, and enables those creatures which are warm-blooded to live in the cold waters, for if there were not a large quantity of non-conducting matter protecting their tissues, they would die, and, no doubt this is the cause of the large quantity of fat which is frequently seen in animals living in cold climates. It likewise seems to serve the purpose of packing. The muscles would not be so perfect in their action if there was not a due quantity of adipose matter deposited between them, and we find in the system wherever there is any want of matter to make up the rotundity of form, the fat is put on. Just as the vendor of earthenware puts in a quantity of straw or wool to keep his wares from breaking—so the fat is put into the system to prevent its being injured by friction or other causes. It is also supplied round the joints in considerable quantities, and seems to act there by diminishing friction, just as we add it to the moving joints of machinery. But there is one important action of fat which differs entirely from those which I have spoken of, and that is, that we find fat existing in the young of the higher animals; and in all cases where tissues are about to be formed, there fatty matter is always deposited. Oil-cells will constantly be seen in proximity to those cells which contain albumen and fibrin; so that these oily matters are of more importance in relation to the health and maintenance of the tissues of the body than sugar or starch. This fact seems, then, to explain what has recently become known: that in certain forms of disease one of the most effectual remedies which can be given is the oil of animals—cod-liver-oil, for instance. It has been known a long time that fish oil would act beneficially in certain forms of disease, but it has not become known generally that it is of most use in those diseases where there is a non-deposit,—where there is a loss of power in the system of depositing this fatty matter, such as in consumption. Hence, in consumption, by giving these oils we supply to the system a large quantity of fatty matter which it deposits, and then we have the beneficial effect following. Generally, the first effect of administering cod-liver-oil is to strengthen the system. It seems to give power to these tissues to develop the nervous and muscular system upon which our lives depend. At one time it was thought that fish oils were the only oils of service, but you may give any oil with advantage. Persons who are getting thin, and especially when their getting thin arises from the deficiency of power to deposit oil in the tissues, should take as great a quantity of fat as they can get in fat meat or in the form of olive-oil, which is taken in large quantities on the Continent. We are more fond of vinegar in our climate. Persons may become disgusted with the smell of cod-liver-oil, and then it becomes of importance to have recourse to olive-oil, almond-oil, butter, cream, or fats. Now I have here some Dugong-oil; persons are in the habit of taking it and find it more effectual than cod-liver-oil, and I told you before that this glycerine, which is contained in all these oils, is being also given, so that it shows it is no substance contained in the cod-liver-oil which does the good, but it is the oily matter itself. It is the carbon and hydrogen which is acting so beneficially upon the system.

I will now call your attention to the sources of those oils and fats which we take unconsciously in our food from day to day. One of the sources of oils and fats in the system is undoubtedly the starch and sugar which we take. I told you, in the last Lecture, that starch and sugar contained a considerable quantity of water. There are 72 parts of carbon, 10 of hydrogen, and 80 of oxygen, in starch and sugar. In oils, the numbers are 66 of carbon, 10 of hydrogen, and 1 of oxygen, or we can express their composition thus:—

	Starch.	Fat.
Carbon	72	66
Hydrogen ..	10	10
Oxygen	80	1

So that you see if I take away some of the oxygen from the first I shall have an approximation to a fat. Now, that can be very easily accomplished. We can withdraw a certain quantity of the oxygen from sugar and starch, and they are converted into fat. Such was the theory of Liebig and Mulder, which was opposed by Dumas and

Boussingault, who said that all fat previously existed in the plant, and that the animal system got it from the plant; and they were very diligent in their analyses to show that wheat had ⅓rd of an ounce of fat in a pound; barley had $\frac{1}{12}$th of an ounce of fat in a pound; rice ¼th of an ounce. Whilst in potatoes there were only $\frac{1}{100}$ths of an ounce, oats had ⅛ths of an ounce of fat in a pound; buckwheat 70 grains of fat in a pound; lentils, peas, and beans, 140 grains in a pound to each; and maize, 1 ounce 101 grains in a pound; and, therefore, said Dumas and Boussingault, the animal system gets the fat from plants. But Liebig, in return, brought forward a case, which is a very interesting one, and that is the case of the Strasburg goose, which has to submit—to gratify the luxuries of mankind—to being tied down to a board and put in front of a fire: they then give him plenty of barley-meal, and he thus takes in much more starch than is necessary to maintain the heat of his body, when the excess forms fat, and the only region in which the fat can be deposited in greatest abundance is the liver, which increases in size until it expands enormously. Then the goose is killed, the liver is taken out, and these distended livers are the precious *morçeaux* contained in the *Pâté de foi gras*, which is so much esteemed; and thus, said Liebig, is the goose exposed to the fire perpetually, converting the starch and sugar into fat.

But there are other cases which seem to prove the same. Wax is a sort of fat, and Professor Milne-Edwards took a quantity of bees, weighed them, and then put them under a glass jar with sugar. The bees were taken at that season of the year when they were making their cells and forming large quantities of wax, and the next day he took the combs and the sugar and the bees and weighed them. The bees had neither lost nor gained, but the sugar had lost exactly as much as there was wax produced. This shows that the little bees had the power of converting the sugar into wax, and in that instance we have almost a crucial proof. We may thus conclude, most properly, that where we do not take any amount of fatty matter in our food, that then we shall convert a quantity of sugar into adipose tissue. But this process is very laborious to the system, and there seems to be no doubt that it is more easy to supply it directly from the Animal or Vegetable Kingdom; and, provided we take a sufficient quantity of potash and soda salts, we shall always be the better for taking small quantities of fatty matter in our food. I will draw your attention to the fact that a large variety of seeds yield oil, —almonds, chestnuts, walnuts, Brazil nuts, Spanish and hazel nuts, hickory nuts, ground nuts, beech nuts, and pistachio nuts, all of them contain oils; and, I believe, most of the seeds which we use as articles of diet contain a greater or less amount of oil. Oil is also expressed from many of these substances.

Then the Animal Kingdom supplies us with a certain quantity of fatty matter, and the most important is milk, which contains 3 per cent. of carbonaceous matter, 4 per cent. of that being butter, which rises on to the top of the milk, and is taken off under the name of cream. When we beat the cream, we separate a certain quantity of the caseine and water which was in the cream, and thus we get butter. This substance contains butyric acid, and it is the evolution of this acid which makes butter so objectionable when it becomes rancid. All these oils have, in fact, the power of producing butyric acid. Butyric oils are not poisonous or injurious, and sometimes persons have been recommended to take cod-liver-oil when it is rancid. I am not, however, aware that there is any beneficial action in the rancidity of oils, although in Kamschatka, and many parts of the world where they are in the habit of keeping animal oil a long time before it is consumed, a taste for this rancidity is acquired, and rancid oil is relished more than the fresh oil.

Respecting the digestion of oils and fats, I may say, that these substances are not so easily digested as starch and sugar, and other articles of food. Persons with delicate stomachs cannot readily digest fat food. They enter into combination with starch, and form with it an indigestible compound,—and hence the objection to toast and pie-crust, which are not easily digested. I mention this for the sake of warning those who are troubled with weak stomachs, although there is no great objection to taking indigestible food, for, in reality, they are not absolutely indigestible, but merely longer in digestion. There are conditions of health in which all these kinds of food, butter, toast, pie-crusts, and even hot buttered rolls, may be taken with impunity, and even perhaps with advantage; but in other conditions of the stomach they ought not to be taken on any account.

NOTICES OF BOOKS, PATENTS, &c.

The Magic of Science. By James Wylde. Griffin and Co., London and Glasgow.

Of all authors, the writer on experimental chemistry for the young must derive the greatest amount of satisfaction from his work. He alone possesses the privilege of combining science with amusement, of conveying the most profound truths under the guise of a brilliant pyrotechnical display, or an experiment which has more than the marvellousness of a conjuror's trick, since it really does what the other only pretends to do. So far are we from agreeing with the author of "The Magic of Science," that boys generally imagine the study of chemistry to be dry and uninteresting, that we believe there is none in which they take so ready and warm an interest; and that this is so is, we conceive, amply proved by the fact that there is no lecture which they attend so willingly; and that not only is it a science which is regularly taught at some of the best of our educational institutions, but which forms the subject of lectures at very many more. For our own part, we cannot remember the eagerly-attentive faces of the young people who attend the Royal Institution to hear Professor Faraday deliver his simple and charming Lectures on Chemistry without the conviction that the lecturer on that science has an advantage in addressing the young over any other scientific man.

As an encouragement to juvenile chemists, and as a source of information and entertainment to those who do not pursue the study of Chemistry as a profession, we have seldom met with any book better calculated to effect these objects than that before us, from the simple and unpretending style in which it is written.

The subjects which the work embraces beside Chemistry are, — Electricity, Frictional and Voltaic; Electro-Magnetism, Heat, Light, Optical Instruments, Pneumatics, Hydrostatics, Mechanics; and, lastly, Various Experiments in Natural Magic. Of course, in a book of this calibre the author does not deal with these matters otherwise than superficially, but in what he does say, he is clear and perspicuous; and from the information being conveyed in the form of "Experiments," the reader is at the same time taught how to conduct them, and imbibes the information as to the reason why certain causes produce certain effects, without the labour of collecting it from a large quantity of print. Neither has the author neglected economical considerations, and the student is in most cases instructed how to prepare the necessary

apparatus for repeating the experiments described, without being obliged to resort to the shop for every article, a powerful obstacle to the study of chemistry, in the case of boys especially, whose supply of pocket-money is usually so disproportionate to the demand upon it.

There are one or two omissions and redundancies in this book; not that they are of very material importance, but, as whatever is worth doing at all is worth doing well, they may as well be mentioned. In describing how to perform certain experiments, the writer is not always sufficiently careful to point out the minor precautions which should be taken. In showing how a kettle filled with boiling water may be taken off the fire, and held on the bare hand without damage to the epidermis, it may not be essential to tell the novice that if a red-hot cinder should happen to be sticking to the bottom and come in contact with the palm of his hand, he had better drop the kettle with as little delay as possible; because he would in all probability do this without being told, and would be taught by the most efficient of all methods to look at the bottom another time before he placed it on his hand; but when the author omits to tell the novice who desires to generate inflammable gas to allow a certain quantity of that which first comes over to escape, so that there may be no admixture of atmospheric air in that he collects, he is guilty of an omission that may give rise to dangerous consequences. In the matter of redundancy we may observe that there is no objection to the introduction of one or two personal anecdotes in a book, more particularly when they are apt illustrations of the point under consideration; but when these are too numerous, they prejudice both the book and the writer in the minds of readers. Anecdotes of this kind are very frequent in the "Magic of Science," and while we would not wish to see them struck out, they might be given in a different form with advantage. This last-mentioned fault, however, is simply a blemish which does not affect the value of the book, which, taken altogether, is one we can favourably recommend to those of our readers who desire to present a young friend with an instructive and interesting work, or who desire to have a manual at hand from which they may, without trouble, compile an amusing lecture for the entertainment of their friends, both juvenile and others.

MISCELLANEOUS.

The Specimen Exchange Club.—In our next Number we expect to be able to lay before our readers some propositions respecting the exchange of specimens, which will, we think, prove acceptable to all who desire to avail themselves of this mode of adding to their collection of chemical rarities.

The Adulteration of Food Act.—At the meeting of the City Commission of Sewers on Tuesday week, Mr. Deputy Barnard, adverting to the Act for Preventing the Adulteration of Food and Drink, which is being now brought into practical operation in the City of London, asked Dr. Letheby, who was recently appointed Public Analyst to the Commission, if any applications had yet been made to him to analyse any article of food or drink? Dr. Letheby said four applications had already been made to him in the interest of the public, and they had reference to the genuineness or otherwise of bread, mustard, milk, and wine. He added, that in his forthcoming quarterly report, he meant to point out the manner in which the public might avail themselves of the protection intended to be afforded by the statute in question. Deputy Barnard said he was gratified by the answer of the Doctor, believing as he did that the Act, if fairly carried out, would prove an immense boon to the public, and especially to the poorer classes.

TO OUR READERS.

The present Number of the Chemical News concludes our Second Volume. The change mentioned in a recent Number will commence with our next issue, when our weekly number of pages will be increased to Sixteen, exclusive of Advertisements, and the price will be raised to Fourpence. At the same time, our Office will be removed to Messrs. Griffin, Bohn, and Co. (late Richard Griffin & Co.), 10, Stationers' Hall Court, E.C.

We have likewise the pleasure to announce that, having received Professor Faraday's special permission to report his Royal Institution Lectures on the Chemical History of a Candle, the first Lecture will appear, reported *verbatim*, and copiously Illustrated, in our next Number. Other important series of Scientific Lectures are in preparation, and will follow in early Numbers.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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*** All *Editorial Communications* are to be addressed to [redacted] and *Advertisements* and *Business Communications* to the Publishers, Griffin, Bohn & Co., at the Office, 10, Stationers' Hall Court, London, E.C.

A Student.—We decidedly think that such a course would not be allowed.

H. Sherman, J. S., and several other correspondents, will receive attention next week.

R. Holliday.—1. The Royal College of Chemistry is, in our opinion, the best school in which a young man can acquire an insight into the Chemistry of any particular branch of manufacture. If he is quite ignorant of the science he would of course have to be well grounded in the elements of the science before he entered upon the special subject which he desired to study; but if he already knew the elements of Chemistry he could commence at once on the subject you mention. 2. We do not know of any one who, having practical experience of the manufacture, would undertake to fit up the apparatus.

Viator.—"Plattner on the Blowpipe" is, we think, the best work you could consult for the purpose.

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